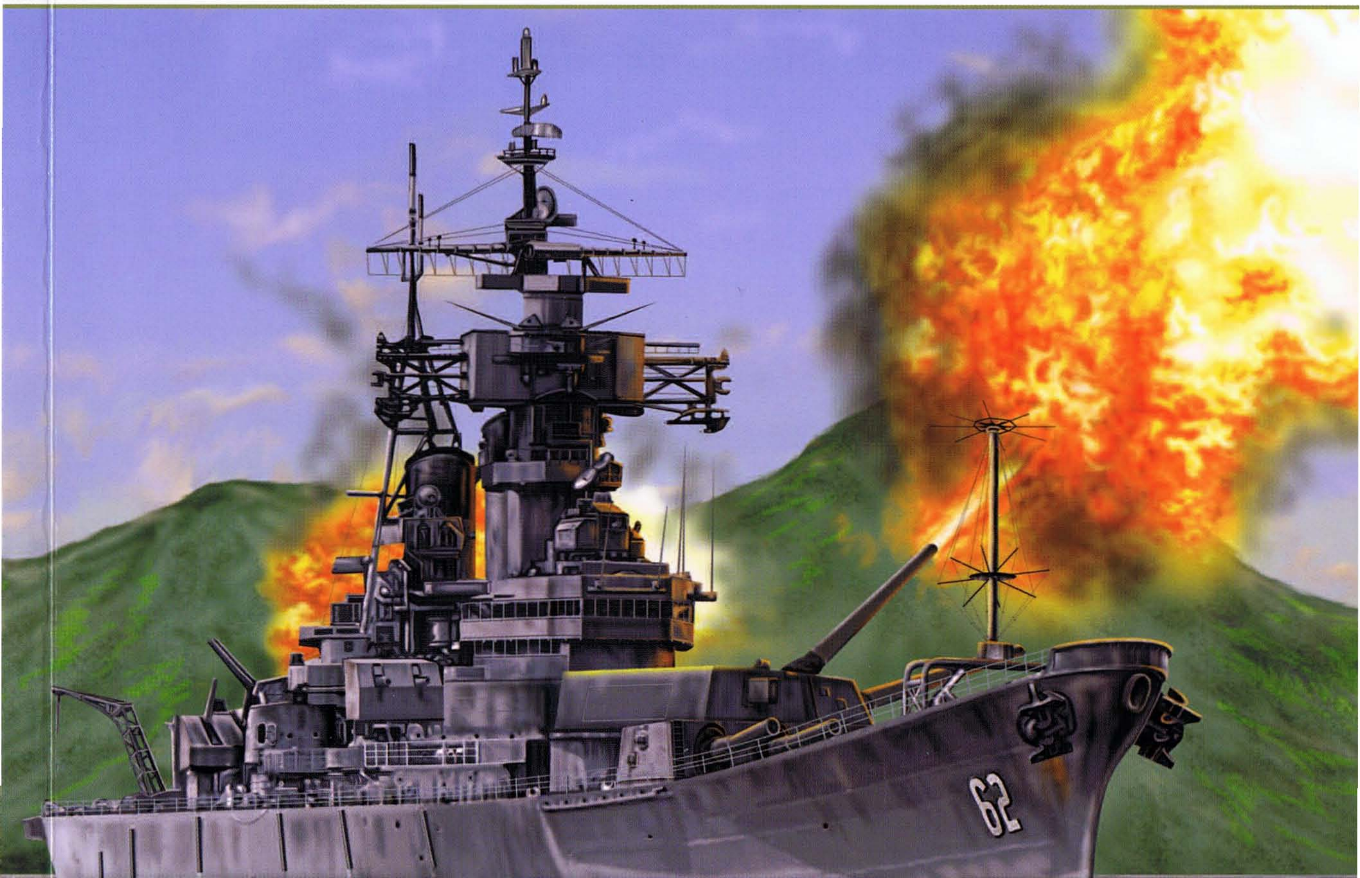
US FAST BATTLESHIPS 1938–91

The Iowa class



LAWRENCE BURR

ILLUSTRATED BY PETER BULL

ABOUT THE AUTHOR AND ILLUSTRATOR

LAWRENCE BURR has had a lifelong passion for naval history. He was recently the British specialist on a Channel 4 documentary about the battle of Jutland. He has also been part of a team who has conducted underwater explorations of the Battlecruiser wrecks and has visited a number of the key battleships detailed in this volume. He lives in the USA.

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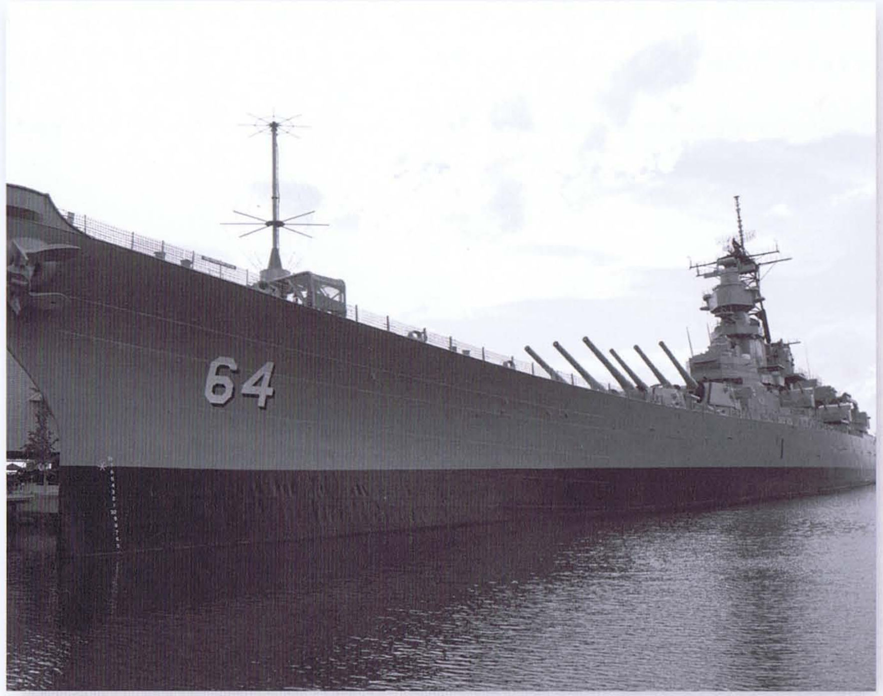

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US FAST BATTLESHIPS 1938–91
THE IOWA CLASS

INTRODUCTION

The North Carolina class of fast battleships marked a significant development from the pre-1922 battleships of the US Navy. Designed to meet the limits established by the Washington Naval Treaty (WNT) of 1922, as well as the width of the Panama Canal, the North Carolina was seen to be unbalanced in design as it had insufficient armor relative to its main armament. The South Dakota class that followed carried adequate armor and was considered to be a successful design. However, with a top speed of 27 knots, these fast battleships were not fast enough for President Roosevelt.

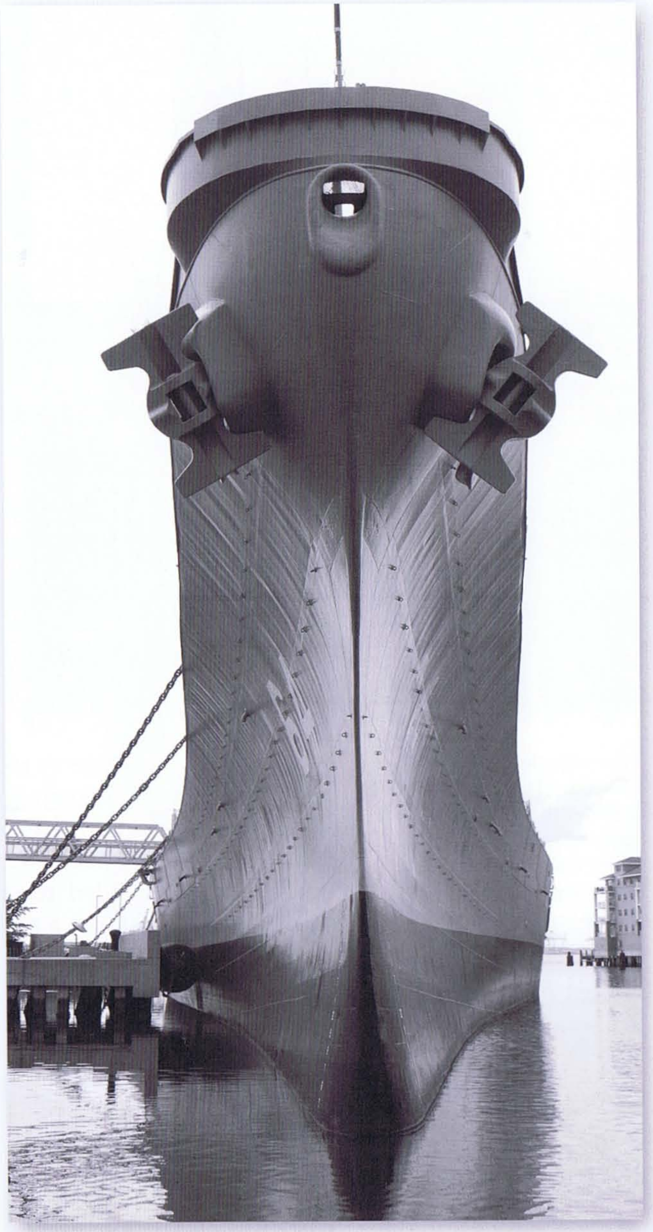
Japan's withdrawal from the Naval Treaty system provided the opportunity to design a battleship unconstrained by treaty limits. As a result, the four battleships of the Iowa class corrected the design shortcomings of both the North Carolina and South Dakota classes, and with a designed speed of 33 knots fulfilled their designation as "fast battleships." The service life of these four ships, from August 1943 until March 1992, demonstrated the quality of their design and construction as well as their capability to deliver accurate and devastating firepower, both conventional and nuclear.

DESIGN AND CONSTRUCTION

When Japan and Italy withdrew from the Naval Treaty system at the Second London Naval Disarmament Conference in January 1936, the US, Great Britain, and France added escalation clauses to the displacement and main armament limits established in the 1922 WNT (displacement of 35,000 tons and 16-inch guns) to cover themselves against new and larger battleships that Japan and Italy might build.

In addition to withdrawing from the Naval Treaty system, Japan became increasingly secretive about its naval construction program, with the result that on March 31, 1938, the US, Great Britain, and France invoked the escalation clause to raise the displacement limit to 45,000 tons. Assumptions were made that any new Japanese battleship would be larger than 35,000 tons and faster than the Kongo class battleships.

The finished design for the South Dakota class overcame the problem of the under-armored and therefore unbalanced design of the North Carolina class, and met the original displacement and armament limits of the WNT. During the design process for both the North Carolina and South Dakota classes, the primary objectives were to maximize armor and armament, with speed a secondary consideration. Nevertheless, these ships were designed with a top speed of 27 knots to be able to match the Japanese Kongo class that the US Navy assumed had a top speed of 26 knots. This assumption was erroneous, however, as the Kongos had undergone a further modernization in the mid-1930s, with new boilers and turbines that resulted in a top speed of 30 knots.



The bow of battleship *Wisconsin*. Without her crew, stores, fuel, and ammunition, *Wisconsin* is riding high in the water. This view shows the long narrow hull, with the bulbous bow stem. These features gave the Iowa class their high speed but a wet forecastle in heavy weather.
(Judi Burr)

The increase of 10,000 tons in displacement, from 35,000 tons to 45,000 tons, provided the opportunity for the General Board of the US Navy to consider either increasing the armament from nine to twelve 16-inch guns and maintaining the top speed at 27 knots, or increasing the top speed of the new battleship to in excess of 30 knots. In March 1938, President Roosevelt played a major role in this consideration by strongly suggesting there should be an increased top speed plus extensive cruising range for the new battleship. The concept of a hybrid battleship–aircraft carrier also resurfaced, with a design of 75,000 tons, twelve 16-inch guns in four turrets, 28 5-inch dual-purpose guns, 36 aircraft and a top speed of 35 knots. The flight deck for the aircraft was to be located amidships. The cost of the ship was estimated to be in excess of $120 million, and doomed this design concept.

Driving the discussion of a new battleship design was an evaluation of what the Navy needed to fight a trans-Pacific war against Japan. The General Board based its requirements on a naval war plan that saw the climax of hostilities being a "decisive" battleship battle somewhere in the western Pacific. The plan assumed that Japan might seek to preserve their battleships until the "decisive" battle, plus use land-based aircraft and Japanese fast battleships, carriers, and cruisers (sailing from their main mid-Pacific base at Truk Lagoon or other anchorages in the Japanese mandated islands of the Marianas, Marshalls, and Carolines) to raid and harass the US Navy fleet of 21-knot battleships as it crossed the Pacific. The vast distances of the Pacific, with long lines of supply and communication, required ships that could meet and defeat these threats.

The need to counter and defeat Japan's fast Kongo class battleships and then overwhelm the Japanese battle line was therefore a major driving force in setting the design criteria for the new ships, as was the restricting width of the Panama Canal. The General Board also saw the need for a striking force ahead of the US battle fleet, comprising fast battleships, cruisers, and carriers, to both parry any Japanese force that might seek to raid the advancing US fleet and to

The forecastle of battleship *New Jersey*. This long forecastle provided the needed buoyancy to the heavy armored amidships section of the ship, containing the armament, magazines, and machinery rooms.
(Judi Burr)

seek out the enemy fleet and bring it to battle. In this "striking force" concept, the carriers were to provide in-depth reconnaissance, and protect the fast battleships from air attack by land and carrier aircraft. Following President Roosevelt's suggestion, in March 1938 the General Board requested a battleship design with 33 knots as top speed. In May 1938, while the design was still being finalized, the *Iowa* and *New Jersey* were formally authorized and assigned to the New York and Philadelphia navy yards for construction.

The design for the Iowa class drew heavily upon the South Dakota class for the form and structure of its armor protection, and the North Carolina class for its bow and hull shape. The required speed of 33 knots needed 230,000 shaft horsepower. The machinery layout of boilers and turbines in one machinery room, as employed in the North Carolina and South Dakota classes, was not viable for the Iowa class. The dimensions of each machinery room would be 64ft, and a torpedo hit at the juncture of two machinery rooms would produce massive flooding. The New York Navy Yard designers therefore reverted to separate boiler and engine rooms on an alternating basis, with four boiler rooms and four engine rooms. Each of the eight spaces was now 32ft, instead of 64ft. Three transverse bulkheads were added to strengthen the total machinery space and the potential flooding from a torpedo hit was halved.

While the need for increased top speed negated the ability to increase main armament from nine 16-inch guns to twelve, the caliber of the nine guns for the Iowa class was increased from 45 to 50. The increase in barrel length and a heavier powder charge produced a muzzle velocity of 2,500 feet per second, compared to 2,300 feet per second for the 16-inch/45 caliber gun. This greater muzzle velocity resulted in a longer maximum range of 42,345 yards and superior armor penetrating capability. During the initial design phases for the Iowa class, the Bureau of Ordnance submitted a design for a 16-inch/50 caliber

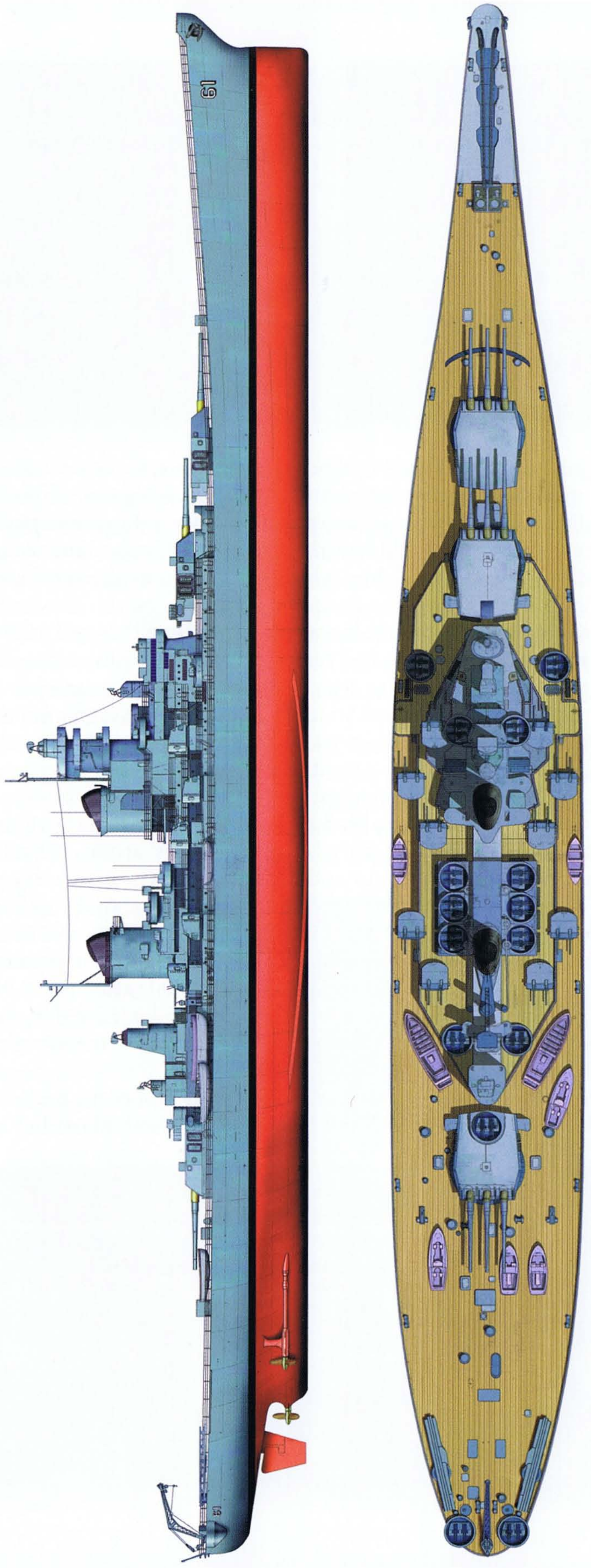
A

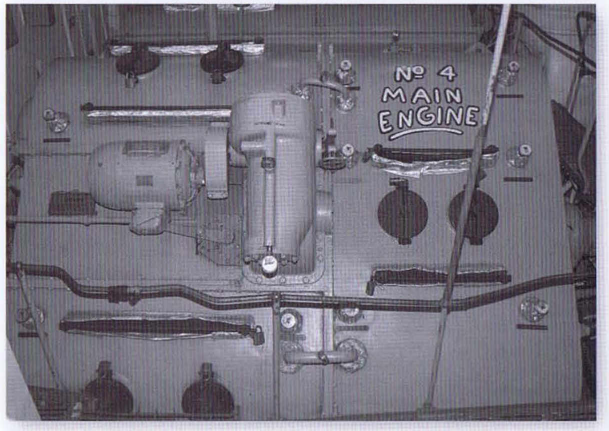
USS *IOWA*, AS OPERATIONAL AUGUST 1943

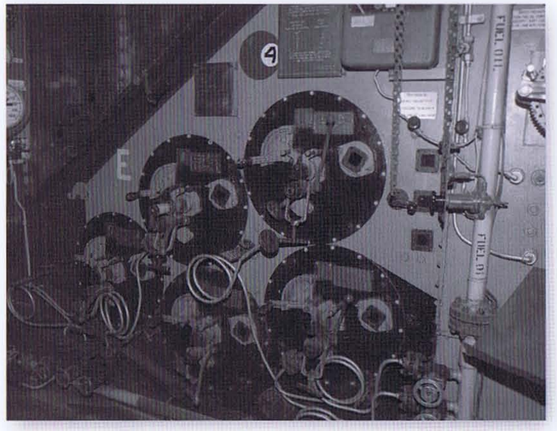
Iowa was the first truly fast battleship for the US Navy. This profile shows the clean lines of the weather deck, the massive superstructure from the conning tower to the fire control tower, and the forward funnel faired into this tower. The profile also shows the large AA battery of 40mm and 20mm guns carried by this class, benefiting from the war experience of the North Carolina class. Additionally, the fire control tower has a platform around it at the 07 level to provide better visibility to the secondary conning station.

The *Iowa* as a Fleet Flagship has an extra level in the conning tower to accommodate an admiral. As a consequence, Turret 2 only carries a 20mm gun and not a quadruple 40mm Bofors gun, which would have impaired the visibility of the lower level within the conning tower.

The rapidly narrowing hull shape from forward of Turret 1 to the bow is clearly identifiable and is a major design feature to provide needed buoyancy and high speed. The twin rudders astern of the inner skeged propellers made the ship highly maneuverable at speed, but sluggish at low speed, and contributed to several groundings.







ABOVE
A Westinghouse geared turbine, driven by high-pressure steam from the boilers. (Author's collection)

ABOVE RIGHT
The face of one of the furnaces of a Babcock & Wilcox boiler, one of eight that provided steam to the turbines to generate the 230,000 shaft horsepower.
(Author's collection)

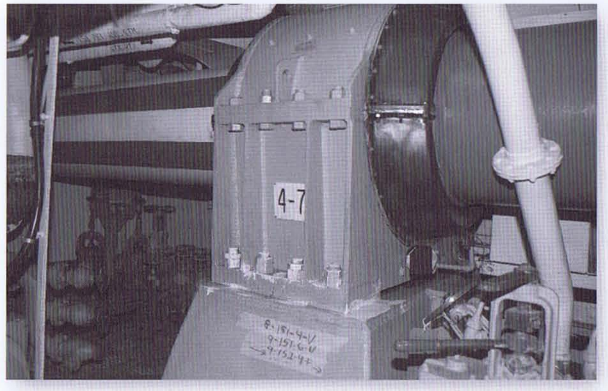
BELOW
One of four propeller shafts painted in red, white, and blue, when the ship was stationary. (Author's collection)

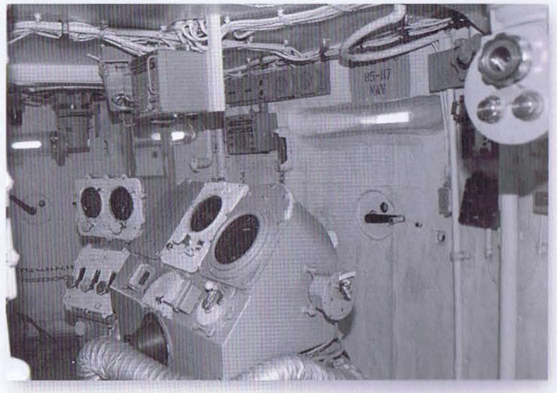
BELOW RIGHT
The steering station within the armored conning tower. The wheel has been removed. The snaking tube is part of the dehumidifying system. Three viewing slots through the 17.5-inch armor are visible, along with two periscopes.
(Judi Burr)

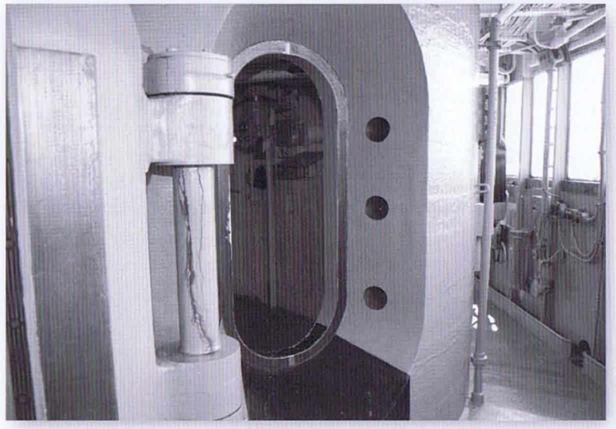
gun in a turret for a 45 caliber gun. However, in the final design of the turret, prepared without consultation with the designers of the hull, the turret diameter was two feet larger than that for a 45 caliber gun. This increased turret diameter would flow through to increase the dimensions of the hull and displacement of the ship, which would then be greater than the 45,000-ton limit and therefore be unacceptable to the Navy. The gun was redesigned retaining the 50 caliber, but with a smaller gun slide and narrower yoke it was able to fit into the same turret size as a 45 caliber gun. The Iowas were equipped with the same 5-inch/38 caliber dual-purpose secondary gun as both the North Carolina and South Dakota classes. A larger 6-inch/47 caliber gun had originally been designed for the ship, but its weight would have been too heavy to fit the displacement limit.

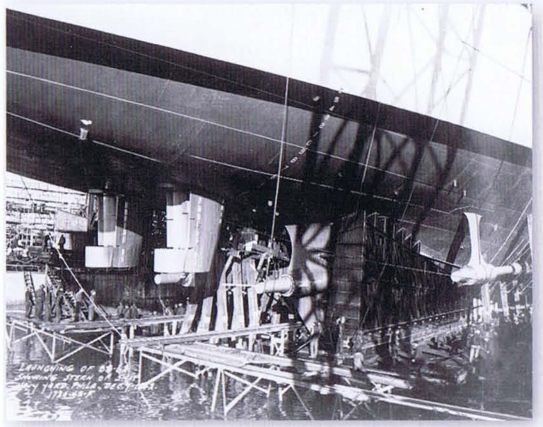
The armor protection encased 464ft of the hull, starting with an armored transverse bulkhead ahead of Turret 1, and ending with another armored transverse bulkhead aft of Turret 3. This armor "citadel" covered the magazines and the boiler and engine rooms. The main side armor belt sloped inwards at 19 degrees to present an acute angle to diving shells, resulting in the 12.1-inch armor plate having the same protective effect as 13.5-inch vertical armor, but without the weight. The armor protection created an immune zone of 12,000 yards between 18,000 yards and 30,000 yards against a 16-inch/45 caliber gun firing a shell weighing 2,240lb. For a 16-inch/50 caliber gun firing a 2,700lb shell, the immune zone shrank to 3,800 yards between 23,600 yards and 27,400 yards.

The Iowas were powered through four propellers, five-bladed for the two inboard propellers and four-bladed for the two outboard propellers. The two inside propeller shafts were contained in skegs, as in the North Carolina class. Twin rudders, aft of the inboard propellers, made the ships very maneuverable.









ABOVE LEFT
The entrance hatch into the armored conning tower. In battle, the captain and his senior officers would take up station within this tower, depending on periscopes and the viewing slits to observe the action.
(Judi Burr)

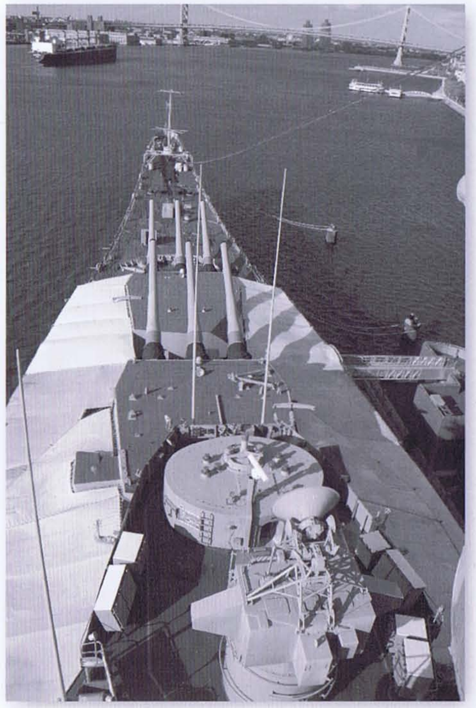
ABOVE RIGHT
USS *New Jersey* ready for launch, showing outboard and inboard propeller shafts and the posts to hold her rudders. The twin rudders positioned astern of the inboard rudders made the Iowa ships highly maneuverable at speed.
(Naval Historical Center)

The large hull dimensions, with a waterline length of 860ft and a maximum beam of 108ft, gave the class the capacity to carry 8,841 tons of fuel, resulting in a high endurance of 15,900 nautical miles at 17 knots.

The Iowas had the sweeping weather deck introduced in the North Carolina class, and a massive superstructure with the fore funnel faired into the rear of the superstructure fire control tower. The size and positioning of the boiler rooms required twin funnels, and the aft funnel structure provided the base for multiple antiaircraft (AA) guns.

The structure of the bridge, conning tower, and fire control tower benefited from the experience gained from the battles of Eastern Solomons and Santa Cruz in 1942 (see NVG 169: *US Fast Battleships 1936–47*). These battles had highlighted the critical importance of conning positions having all-round visibility during air actions. "Stryker's Bridge," an all-round walkway platform built at the secondary conning position, level 07, on the fire control tower of USS *North Carolina* after the battle of the Eastern Solomons, was incorporated into the design of all the Iowas.

The USS *Iowa*, built as a Fleet Flagship, had an enlarged conning tower to accommodate an admiral. As a consequence, the quadruple Bofors gun on Turret 2 was omitted, as it would have blocked the sight lines from the lower level of the conning tower. The USS *Iowa* carried the full complement of ten 5-inch gun turrets, unlike the USS *South Dakota*, which carried two fewer 5-inch gun turrets than the other members of her class, in order to better accommodate an admiral and his staff.



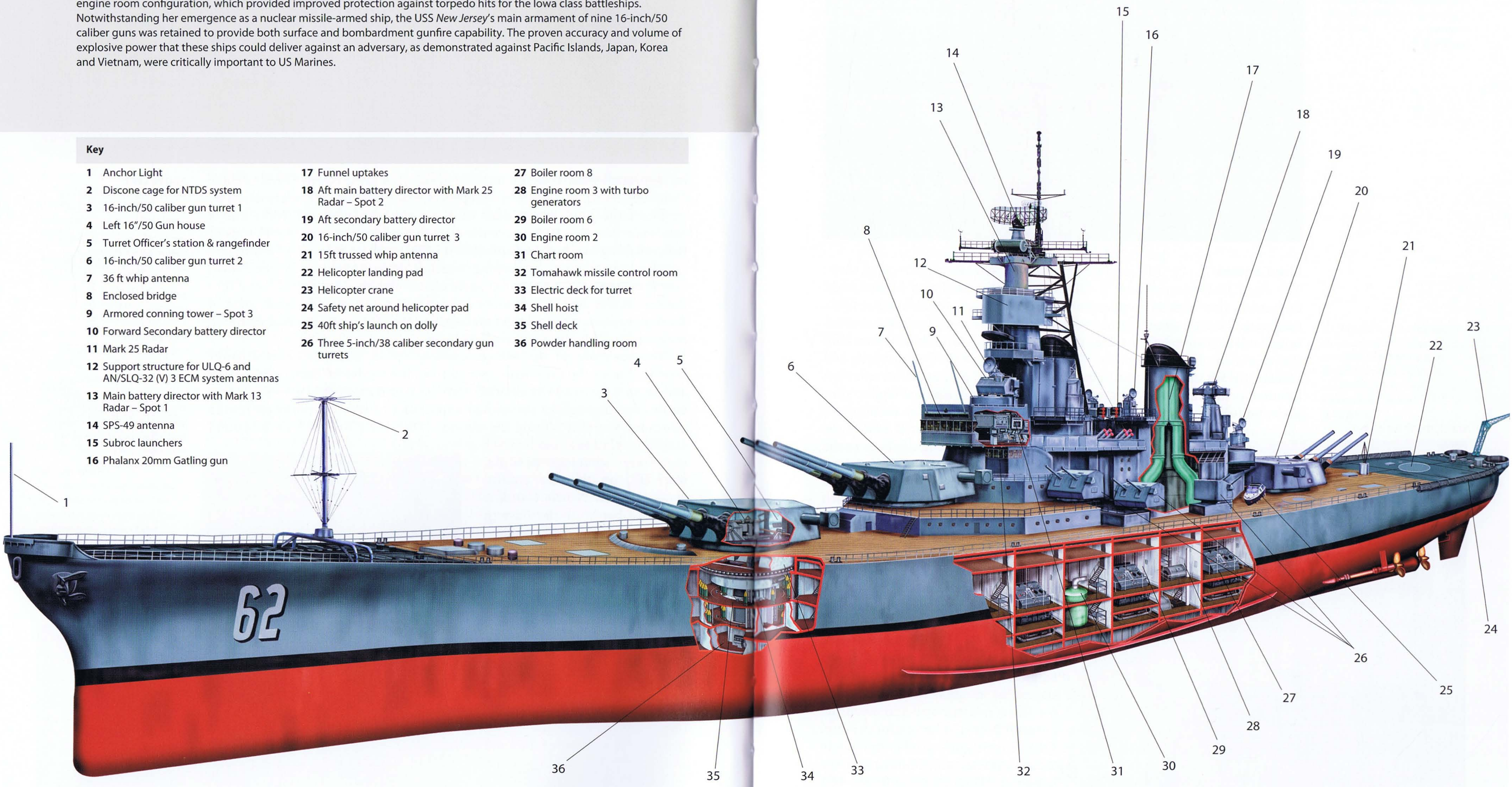
The view from Sky Control. The roof of the circular armored conning tower with periscopes protruding can be clearly seen, together with the forward Mark 37 director. Air defense was directed from this location as it had the greatest visibility around the ship. Note the conning position, just forward of the Conning Tower.
(Author's collection)

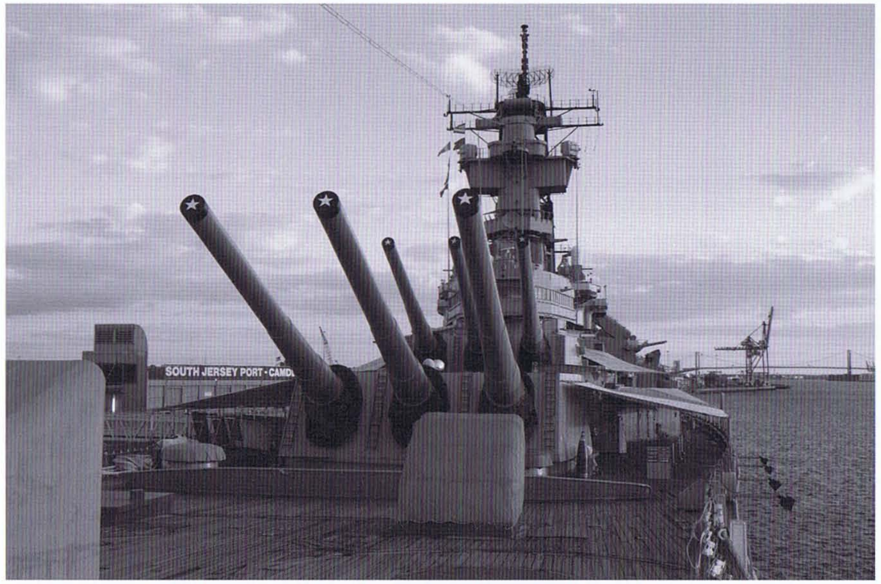
B USS *NEW JERSEY*

This drawing shows USS *New Jersey* following her 1982 modernization and reactivation at Long Beach Naval Yard. The USS *New Jersey* was the first of the four Iowa class battleships to be modernized as she was in the best condition, resulting from her service in the Vietnam War. The USS *New Jersey* is bristling with new antennas for Electronic Counter Measures and new armament comprising 32 Tomahawk missiles and 16 Harpoon anti-ship missiles. Clearly shown is the alternating boiler and engine room configuration, which provided improved protection against torpedo hits for the Iowa class battleships. Notwithstanding her emergence as a nuclear missile-armed ship, the USS *New Jersey*'s main armament of nine 16-inch/50 caliber guns was retained to provide both surface and bombardment gunfire capability. The proven accuracy and volume of explosive power that these ships could deliver against an adversary, as demonstrated against Pacific Islands, Japan, Korea and Vietnam, were critically important to US Marines.

Key

1 Anchor Light
2 Discone cage for NTDS system
3 16-inch/50 caliber gun turret 1
4 Left 16"/50 Gun house
5 Turret Officer's station & rangefinder
6 16-inch/50 caliber gun turret 2
7 36 ft whip antenna
8 Enclosed bridge
9 Armored conning tower – Spot 3
10 Forward Secondary battery director
11 Mark 25 Radar
12 Support structure for ULQ-6 and AN/SLQ-32 (V) 3 ECM system antennas
13 Main battery director with Mark 13 Radar – Spot 1
14 SPS-49 antenna
15 Subroc launchers
16 Phalanx 20mm Gatling gun
17 Funnel uptakes
18 Aft main battery director with Mark 25 Radar – Spot 2
19 Aft secondary battery director
20 16-inch/50 caliber gun turret 3
21 15ft trussed whip antenna
22 Helicopter landing pad
23 Helicopter crane
24 Safety net around helicopter pad
25 40ft ship's launch on dolly
26 Three 5-inch/38 caliber secondary gun turrets
27 Boiler room 8
28 Engine room 3 with turbo generators
29 Boiler room 6
30 Engine room 2
31 Chart room
32 Tomahawk missile control room
33 Electric deck for turret
34 Shell hoist
35 Shell deck
36 Powder handling room

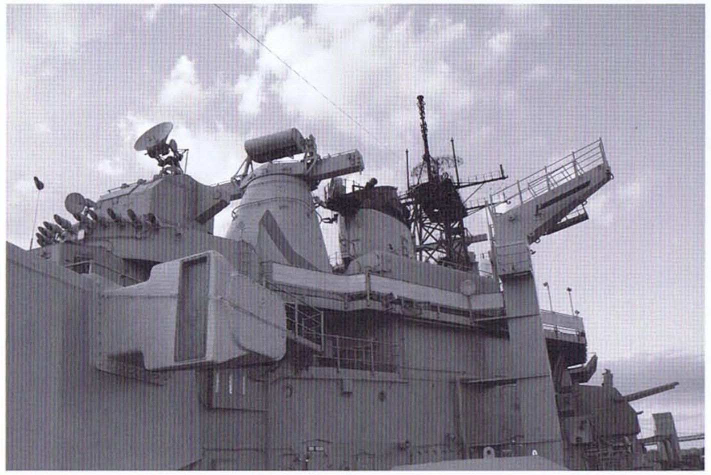




Spot 1, the Mark 38 director with its optical rangefinder and fire control radar, is clearly seen at the top of the superstructure tower. The armored conning tower is enclosed behind the windows of the bridge structure.
(Judi Burr)

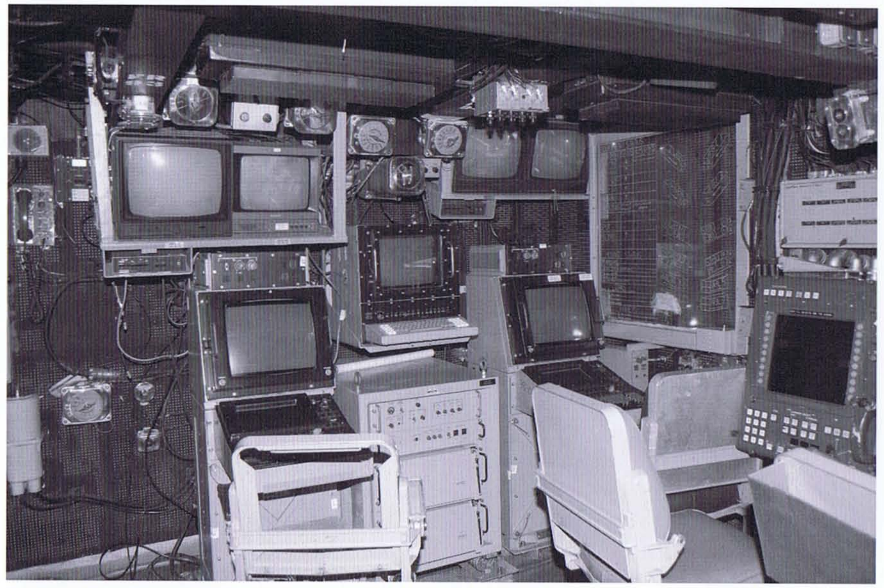
Fire Control

The Ford Instrument Mark 8 rangekeeper was the heart of the main armament fire control system for the Iowa class 16-inch guns. This mechanical analog computer consolidated the input from optical and radar rangefinders for range, bearing, and target speed; it included own ship movement in all axes from the Mark 41 stable vertical gyroscope, and ballistic details of wind, atmospheric pressure, and gun conditions; it then calculated future target range, gun deflection, and time of flight, thus providing the required gun elevation and turret train input to the guns electronically. The rangekeeper and its backup were located below the armored deck in the main and aft battery plotting rooms. In addition to the rangekeeper, the plotting rooms also contained a Mark 41 stable vertical gyroscope that measured the roll and pitch of the ship for input to the rangekeeper, and a fire control switchboard that allowed the function of each plot to be switched to its backup in the event of battle damage or malfunction, or to allow each spot director to engage a separate target.



Spot 2, the aft fire control director and tower, located aft of the second funnel. A Mark 37 secondary director is seen just forward of Turret 3; its hood for the optical rangefinder is visible. The angled upright is the refueling boom to extend fuel lines to ships alongside.
(Judi Burr)

The optical and radar rangefinders were located in two Mark 38 directors. One, referenced as Spot 1, was located atop the forward fire control tower; the other, Spot 2, was located at the aft end of the superstructure just forward of Turret 3. These two spots with their high elevation, 116ft for Spot 1 and 68ft for Spot 2, were able to detect targets at a greater distance than the three gun turrets, and were the primary spotting locations for the ship. The 16-inch gun turrets could only mount optical rangefinders, but the large size of the turrets allowed 46ft rangefinders to be installed in the gun captain's cabin at the aft end of each gun turret. Turret 1 had a Mark 53 coincidence rangefinder that could range on points of light. Turrets 2 and 3 had Mark 52 stereoscopic rangefinders.

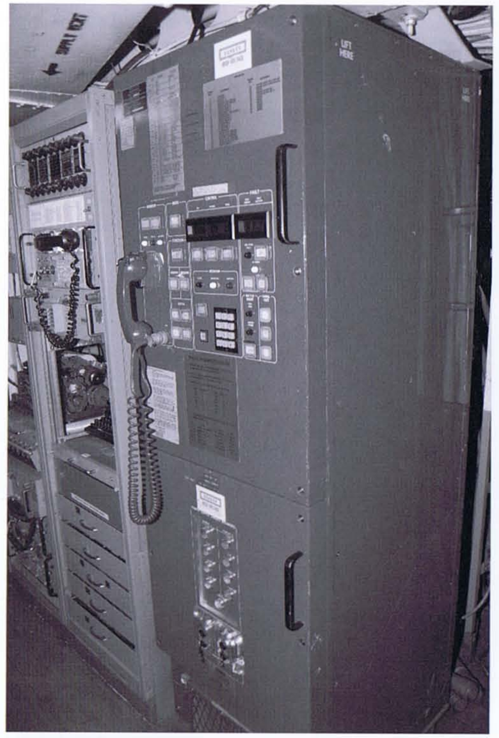


The combat engagement center on level 02. This is the brains of the fighting ship, where all sensors are viewed to determine threat levels and which armament to use to defeat the threat.
(Judi Burr)

The upper level of the armored conning tower comprised a Mark 40 director, equipped with three periscopes for use by the gunnery officer and his staff to direct and then monitor the main armament gunfire on the target. This director is referred to as Spot 3.

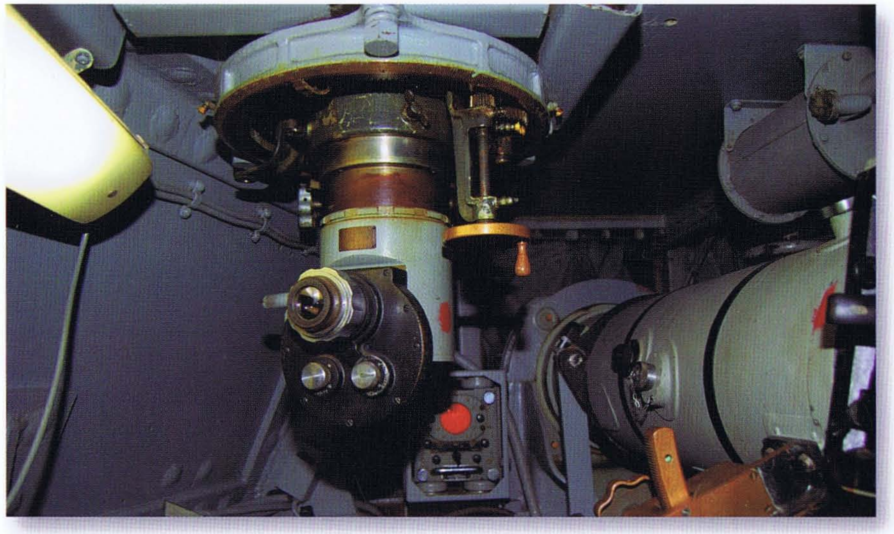
Radar had developed while the ships were being built and the Iowas were equipped with Mark 8 fire control radar sets, which were an advance on the Mark 3 sets originally fitted to the North Carolina and South Dakota class battleships. The Mark 8 sets had antennas comprised of numerous polyrods that emitted timed pulses at ten scans per second along a narrow 10cm (4in) beam. The Mark 8 was the first phase scanning radar set used in the US Navy, and could range out to 40,000 yards, matching the range of the 16-inch guns. The Mark 8 radar sets were fixed atop the Mark 38 directors. A Mark 3 fire control radar set was located on the Mark 40 conning tower director on the USS *Iowa* and *New Jersey*. A development of the Mark 3, the Mark 27 fire control radar, was fitted to USS *Missouri* and *Wisconsin*.

The secondary armament of dual-purpose 5-inch guns was controlled by four Mark 1 secondary battery computers, located in separate plotting rooms adjacent to the main plotting rooms forward and aft. These computers were each coupled with one of the four Mark 37 directors, one forward, one aft, and one either side of the ship. The Mark 1 computer performed the same tasks as the Mark 8, but had to be quicker to allow for fast-moving targets, and it incorporated target altitude for its antiaircraft role. The Mark 37 directors for *Iowa* and *New Jersey* were fitted with Mark 4 radar sets, but the returning signal from these sets was affected by interference. A Mark 12 radar set was developed to eliminate such interference and



The big red box that carries the communications governing the use and release of nuclear-armed Tomahawk missiles. Located in the combat engagement center.
(Judi Burr)

The commander's periscope inside the Spot 1 Mark 38 director. The periscope brings the director onto the target for the optical rangefinder, the tube to the right, to calculate the range to target. This information is transmitted to the Mark 8 rangekeeper. (Author's collection)

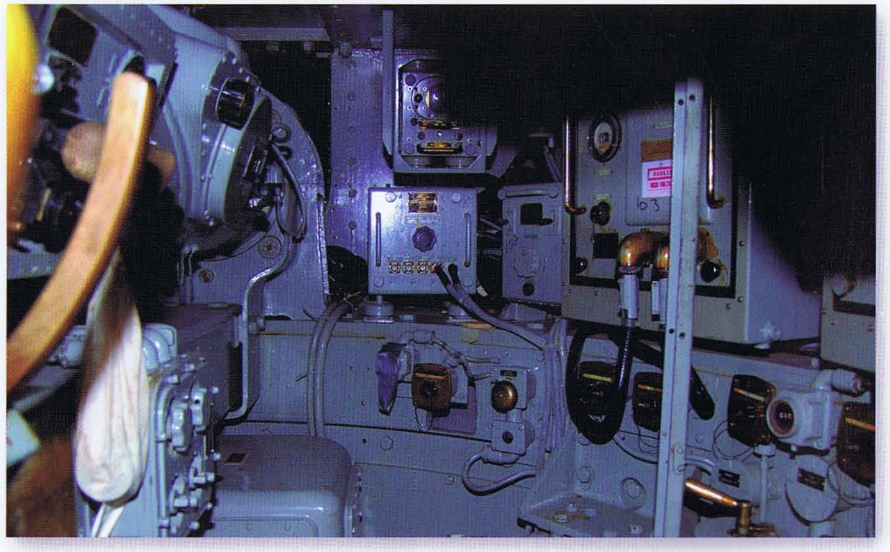


these models were installed on the *Missouri* and *Wisconsin*, with the *Iowa* and *New Jersey* receiving upgrades in 1945 and 1944 respectively.

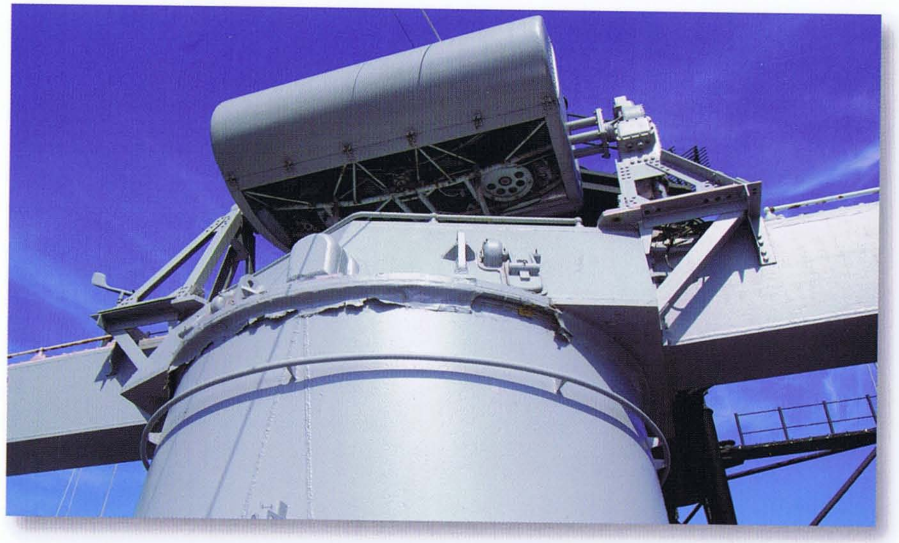
Individual Mark 14 gun sights, based on gyroscopes that helped 20mm gunners compute the lead angle needed to hit a fast-moving aircraft. Tracer bullets also assisted the gunner in judging the lead angle. The 40mm Bofors guns were controlled by a Mark 51 director located close to, but above each gun. The director was based upon the Mark 14 gun sight and the elevation and train were transmitted to the power drives of the Bofors.

Radar

In addition to fire control radar, Iowa class battleships carried radar for air and surface search. Air search radar initially installed was the SK bedspring radar (with the exception of USS *Missouri* which was fitted with the later SK-2 parabolic radar set). These sets could locate aircraft out to 100 miles, but were restricted in height to 10,000ft. Surface search was performed by SG sets with two per ship. The SG radar could locate targets in excess of 20 miles, and aircraft at 15 miles and 500ft. In addition to surface search, the SG radar also provided navigational input through its ability to clearly delineate land mass. It was also used in conjunction with fire control radar, as its wider search beam could help the Mark 8 radar locate the target.



A view across the Mark 38 director, with the rangefinder on the left. (Author's collection)

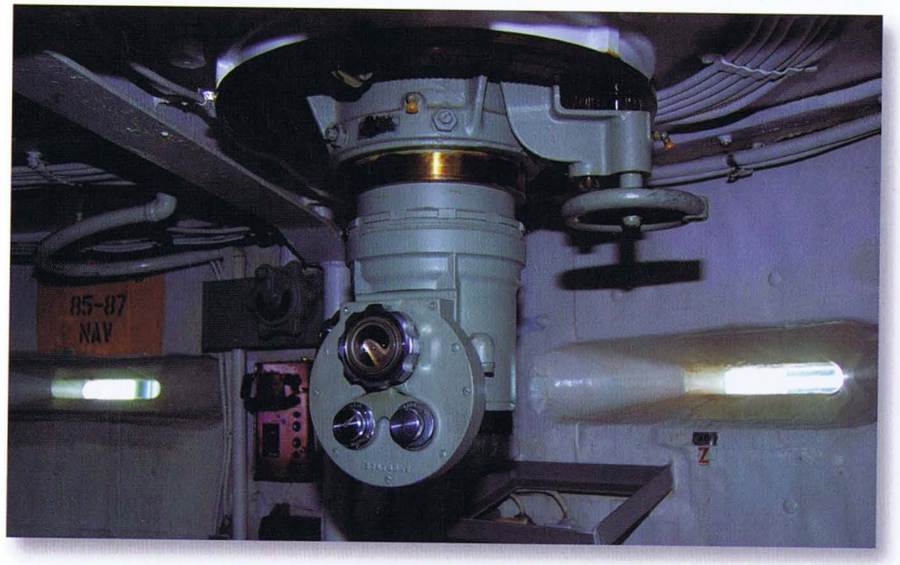


An external view of the Mark 38 director, fire control radar, and the two arms enclosing the optical rangefinder. (Author's collection)

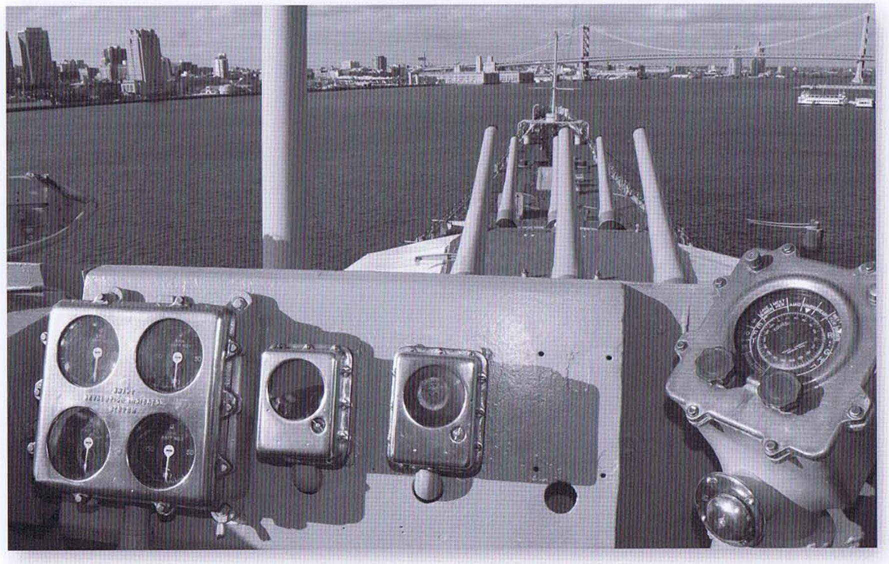
Aircraft

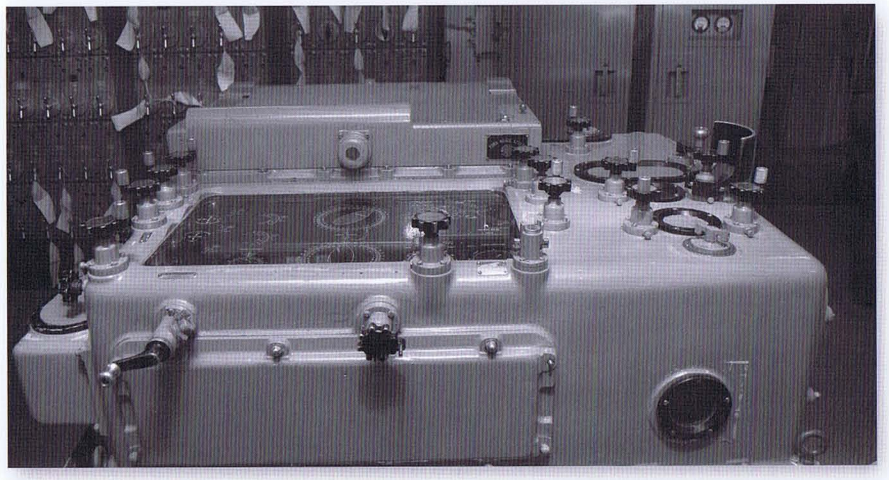
The Iowa class battleships each carried three aircraft, primarily for spotting the fall of shot from the main armament during long-range gunfire. The aircraft were also used for antisubmarine patrols, air-sea rescue, and communicating with shore stations.

The aircraft, OS2U Vought Sikorsky Kingfishers, were launched from one of two 68ft catapults located port and starboard at the stern of the ship. Two aircraft were carried on the catapults with the third aircraft stowed on a dolly between them. The Kingfisher was a single float aircraft that would land on a slick of still water created by the battleship turning 90 degrees across the wind. It would then taxi up to a rope sled being towed at the stern of the ship, and to which a hook on the underside of the float would engage. From there the aircraft crane would hoist the Kingfisher back on board.



The gunnery officer's periscope through which gunfire is monitored to ensure the correct target is being fired upon. In the event Spots 1 and 2 are disabled, gunfire would be directed from this location. (Judi Burr)





ABOVE
This was the preferred captain's conning position prior to battle, located outside the conning tower.
(Judi Burr)

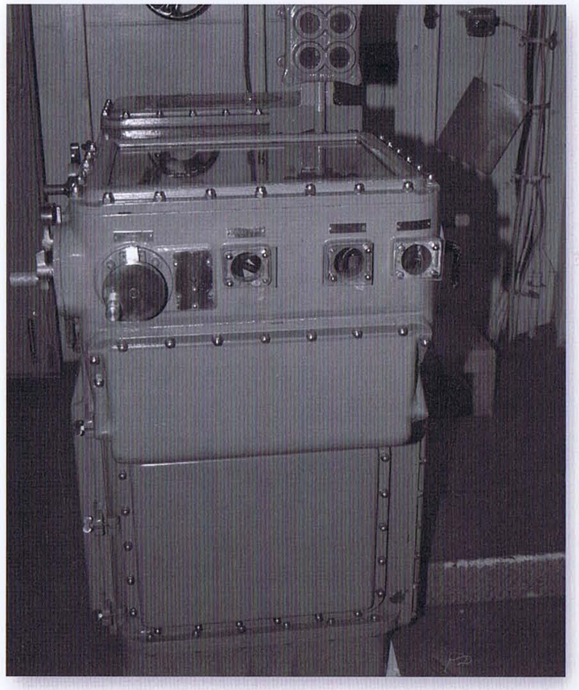
BELOW
The Ford Instrument Mark 8 rangekeeper, the computational brains of the fire control system. Receiving inputs from radar and optical rangefinders, ballistic information, and own ship's movement, it would calculate the train and elevation for the guns. Behind the rangekeeper is the switchboard controlling the flow of information from directors and to turrets.
(Author's collection)

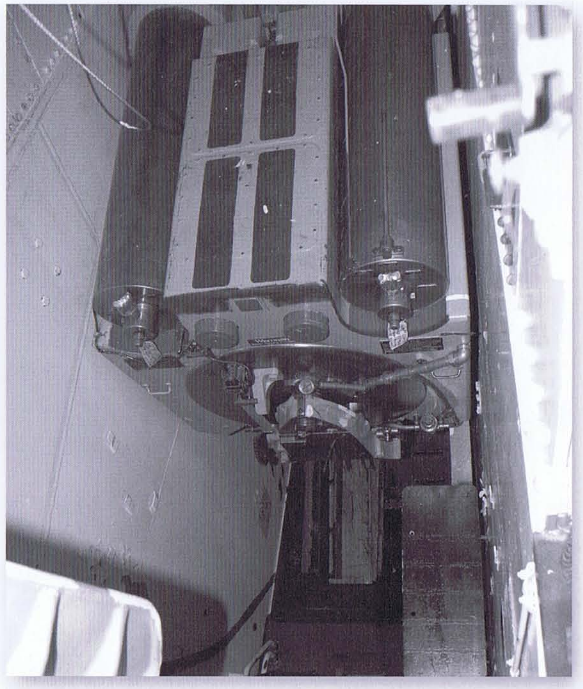
Construction Timetable

The *Iowa* and *Missouri* were built in the New York Navy Yard, which also acted as the lead yard for final detail design. The *New Jersey* and *Wisconsin* were built in the Philadelphia Navy Yard. Reflecting how American shipbuilding was geared up for wartime construction, milestones during the construction of these ships were as follows:

Milestone	*Iowa*	*New Jersey*	*Missouri*	*Wisconsin*
Keel laid	6/27/1940	9/16/1940	1/6/1941	1/25/1941
Launched	8/27/1942	12/7/1942	1/29/1944	12/7/1943
Commissioned	2/22/1943	5/23/1943	6/11/1944	4/16/1944
Operational	8/1943	12/1943	12/1944	9/1944

Two additional Iowa class battleships were authorized in July 1940 as part of an emergency program following the fall of France. The *Illinois* and *Kentucky* were ordered in September 1940, but were never completed.





ABOVE LEFT
The Mark 41 stable vertical gyroscope. This computer, driven by a gyroscope, measured the roll, pitch, and yaw of the ship together with its heading and speed for input to the rangekeeper.
(Author's collection)

ABOVE RIGHT
The gun house for the yoke and breech of a 16-inch/50 caliber gun depressed for firing. When the breech is opened, it pivots downward to allow the spanning tray to extend into the open breech. The explosion in the middle gun house on board USS *Iowa* blew out the bulkheads separating the middle gun from the port and starboard gun, as well as into the gun captain's compartment, behind a bulkhead, at the rear of the gun.
(Author's collection)

IOWA CLASS OPERATIONS

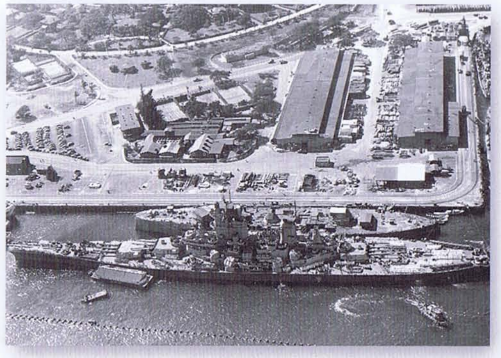
World War II

In August 1943, the USS *Iowa* was the first ship of the class to enter the war zone, sailing to Argentia, in Newfoundland, to provide distant cover for North Atlantic and Russian convoys should the *Tirpitz* emerge from her Norwegian fjord. This danger was negated when, in September 1943, Royal Navy midget submarines exploded four mines beneath *Tirpitz*'s hull while she was anchored in Kafjord, requiring repairs to the German ship over the next six months.

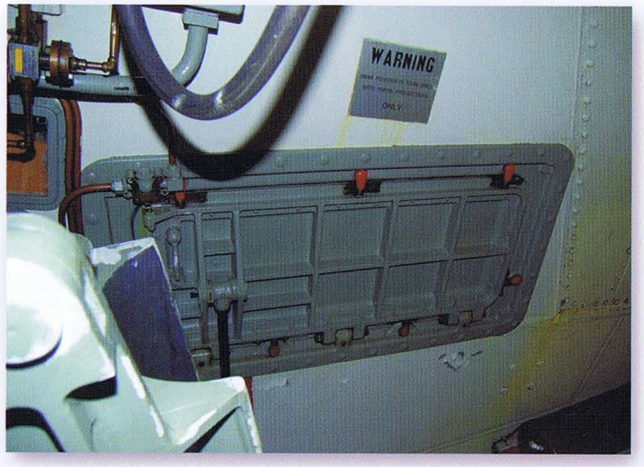
On November 14, 1943, the USS *Iowa* departed Hampton Roads. On board were President Roosevelt and the Joint Chiefs of Staff who were to attend war-planning conferences in Cairo and Tehran. While crossing the Atlantic, escorting destroyers carried out practice torpedo attacks on the *Iowa*. USS *William D. Porter* actually fired a torpedo because a primer, which should have been withdrawn for practice firings, had been left in the firing mechanism. USS *Iowa* turned towards the torpedo, which exploded off the starboard quarter, causing some excitement and inter-service banter between the Chiefs of Staff.

Following her return to the US with President Roosevelt on board, USS *Iowa* then sailed for the Pacific with USS *New Jersey* and joined the 5th Fleet on January 22, 1944, at Ulithi, in the Caroline Islands.

The first and only time these two battleships opened fire on enemy ships was on February 16, 1944, during an attack on Truk Lagoon, which



LEFT
USS *Wisconsin* berthed in Pearl Harbor, preparing for her assignment to the Pacific. The *Wisconsin* is alongside the hulk of USS *Oklahoma*. Note the torpedo net buoys protecting the ships.
(Naval Historical Center)



The closed door to the powder hoist, which opens downward to form a tray over which the powder charges roll into the spanning tray for loading into the breech. This door was open when the charges exploded in the open breech of USS *Iowa*. (Author's collection)

was the main Pacific base for the Imperial Japanese Navy (IJN). Two heavy cruisers and four destroyers accompanied *Iowa* and *New Jersey*. Although the majority of IJN vessels had already escaped from Truk, the light cruiser *Katori*, two destroyers, *Maikaze* and *Nowaki*, and the minesweeping trawler *Shonan Maru No.15* were located both by lookouts and radar at 1500hrs, bearing from 250 degrees to 270 degrees, at ranges between 22,000 and 33,000 yards. US destroyers attacked the *Shonan Maru No.15* and immobilized her. At 1527hrs, when the range had fallen to 800 yards, *New Jersey* fired on the minesweeper with her 5-inch guns. *Shonan Maru No.15* promptly blew up and sank. The *Katori* had already been stopped by bomb damage inflicted by a US carrier aircraft, and sank after being pummeled by USS *Iowa* with both 16-inch and 5-inch shells at an opening range of 17,400 yards. The 5-inch guns were fired under radar control as the smoke from *Iowa*'s main battery obscured the target for the Mark 37 directors. *New Jersey* then fired her 5-inch guns and sank *Maikaze*. Both *Iowa* and *New Jersey* commenced firing on *Nowaki*, at a range of 32,000 yards, at 1547hrs. The two battleships logged in excess of 32 knots in pursuit of *Nowaki*, which they straddled with their first salvoes. As *Nowaki* sped into the setting sun and opened the gun range, she disappeared optically over the horizon at 35,500 yards. However, the Mark 8 radar on Spot 1 was still able to register on her mast tops and shell splashes out to 39,000 yards, with optical spotting provided by covering carrier aircraft. Ceasefire was ordered at 1558hrs, and *Nowaki* escaped. During the engagement three air attacks were made on the US ships, but no damage was sustained. Following the conclusion of the action, the two battleships and their escorts sailed around Truk Lagoon, referred to as Japan's Pearl Harbor, to demonstrate the advance and power of the US Navy in the Pacific.

Iowa and *New Jersey* were joined in the Pacific by *Wisconsin* on December 9, 1944, and *Missouri* on January 6, 1945. These four battleships took part in the following operations:

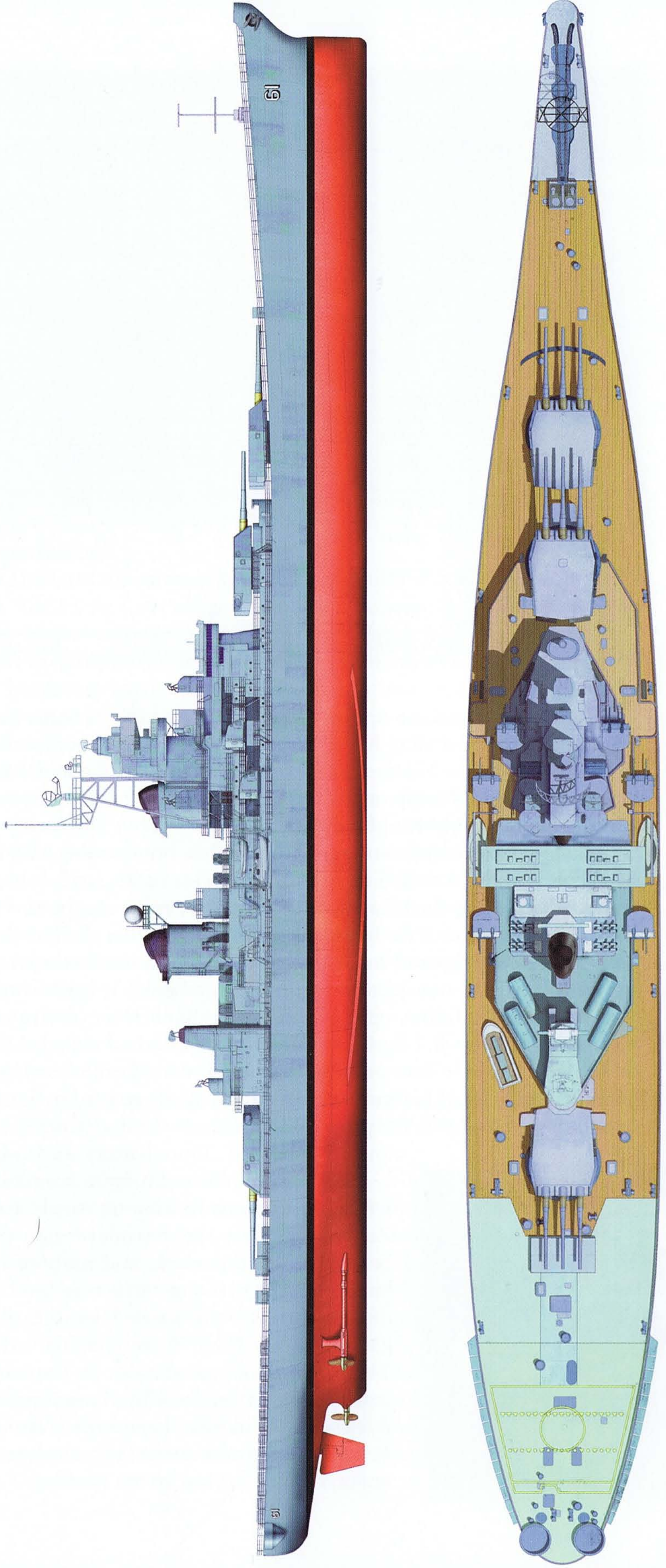
C

USS *IOWA*, AS OPERATIONAL APRIL 1984

Forty-one years after first being commissioned, *Iowa* has lost the AA 40mm and 20mm guns. The bridge has been enclosed and a tripod foremast added over the forward funnel to provide the base for the SPS-67 surface search radar and related antennas. The sky control bridge has been enlarged to house the SLQ-32(V) 3 ECM system and a radar to locate enemy aircraft and missiles. The dome attached to the aft funnel contains the control antenna for the Pioneer drone.

The fantail has lost the Kingfisher aircraft and catapults, and is configured for helicopters. Overlooking Turret 3, beneath the Mark 37 director, is the helicopter control station. Three helicopters were stowed on the fantail aft of Turret 3.

The major features are the removal of four 5-inch gun turrets from the 02 level to provide the space for four armored boxes containing 16 Tomahawk missiles. Four additional armored boxes for Tomahawk missiles are positioned on the 03 level adjacent to the aft fire control tower. The launchers for the Harpoon antiship missiles are located adjacent to the aft funnel. The four Phalanx 20mm close-in weapon systems are located on the 05 level, with two just forward of the aft funnel and two either side of the forward edge of the fire control tower.



Operation	Date	*Iowa*	*New Jersey*	*Missouri*	*Wisconsin*
Kwajalein/Marshall	1/1944	√	√	X	X
Truk/Marianas	2/1944	√	√	X	X
Palau	3/1944	√	√	X	X
PNG/Palaus	4/1944	√	√	X	X
Marianas/Philippine Sea	6/1944	√	√	X	X
Leyte	10/1944	√	√	X	X
Mindoro/Luzon	12/1944	X	√	X	√
Luzon/South China Sea	1/1945	X	√	X	√
Iwo Jima	2/1945	X	√	√	√
Inland Sea of Japan	3/1945	X	√	√	√
Okinawa	4/1945	√	√	√	√
Kyushu	5/1945	√	X	√	√
Hokkaido	7/1945	√	X	√	√
Honshu	7/1945	√	X	√	√
Tokyo	7/1945	√	X	√	√

Note: X means that the ship was unavailable for this operation.

The majority of these operations involved multiple actions, and multiple roles, including providing AA protection to the carriers, bombarding islands to be invaded by the Marines and Army, bombarding Japanese steel and iron works, supplying accompanying ships with fuel, and rescuing downed airmen by utilizing the ships' Kingfisher float planes.

The *Iowa* was hit by two enemy shells while bombarding Mili Atoll in the Marshall Islands. A 6-inch shell hit the left side of Turret 2, with fragments from the exploding shell damaging the left pointers periscope and the glass in the left end window of the turret rangefinder. The other shell, with a 4.5-inch base plug, struck the port hull adjacent to frame 134 and created a hole 30in by 50in, but did not penetrate the next inboard torpedo bulkhead. In December 1944, following a typhoon that sank three destroyers, *Iowa's* number three propeller shaft began to vibrate as it had dropped three inches in its strut bearing. Temporary repairs were made in the floating dry dock, anchored at Manus, before *Iowa* sailed for the navy yard in San Francisco. In addition to repairing the propeller shaft, a new bridge structure, radar sets, and an improved 20mm battery were added.

A Japanese Zeke kamikaze aircraft about to hit the starboard hull of USS *Missouri*. If the Zeke had hit the ship's superstructure, the casualties among the AA crews would have been very high. (Naval Historical Center)

USS *Missouri* was hit by a kamikaze aircraft while off southern Kyushu on April 11, 1945. The Zeke fighter hit the starboard side of the ship below the weather deck, and parts of the aircraft landed on the first superstructure level. A number of small fires were caused by the plane's spilt gasoline, but these were quickly extinguished. There were no casualties. If the aircraft had crashed higher on the ship, casualties among the AA crew would have been high. *New Jersey* and *Wisconsin* did not suffer any damage by enemy action during the war in the Pacific.

The ramming lever that controls the speed and extension of the power ram to push first the shell and then the powder bags into the breech. It is considered that a fast over-ram of the powder charges against the base of the shell initiated the explosion on *Iowa*. (Author's collection)

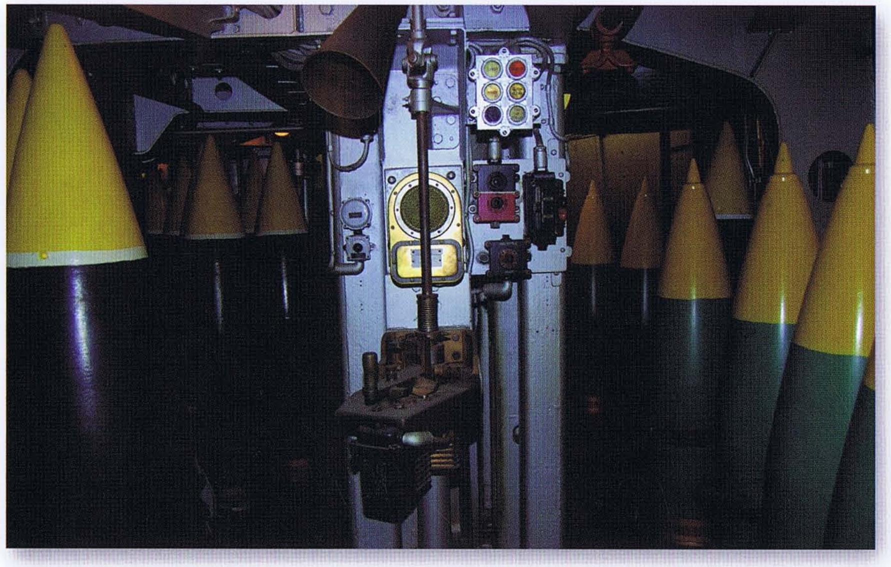
Missed Opportunities

The Iowa class battleships were designed and built for action against enemy battleships. Their speed, armor, guns, and radar-equipped fire control system made them the most powerful battleships of World War II. However, they were to miss three opportunities to take on the battleships of the IJN in the "decisive" battleship battle that the war plans of both the US Navy and the IJN had envisaged prior to the outbreak of war.

The Battle of the Philippine Sea

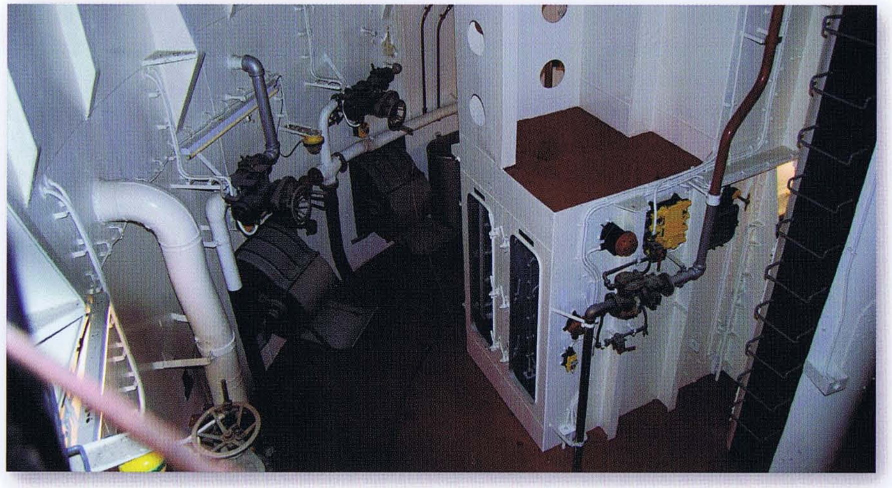
The US invasion of the Marianas in June 1944 prompted the IJN to commit itself to a "decisive" naval battle. It assembled in its Mobile Fleet, under Admiral Ozawa, nine aircraft carriers and five battleships including *Musashi*, *Yamato*, and the two fast battleships *Kongo* and *Haruna*. Admiral Ozawa placed these four battleships in the vanguard of his fleet using both their main armament and AA guns to bear the brunt of any initial attack. After combining the elements of his fleet together and refueling his ships, Admiral Ozawa approached the Marianas from the southwest. Admiral Mitscher, commanding Task Force 58 with 15 aircraft carriers and seven fast battleships under the command of Admiral "Ching" Lee, positioned his fleet to the northwest of the Marianas. Admiral Ozawa used the long range of his patrol aircraft to locate Task Force 58. Admiral Mitscher used sighting reports from US submarines that were following the Mobile Fleet to establish the position of the enemy.

On Sunday morning, June 18, 1944, Admiral Mitscher calculated that if he sailed westward he could launch an air attack on the Mobile Fleet by late that afternoon, and then use Admiral Lee's seven fast battleships, including *Iowa* and *New Jersey*, to destroy any remaining IJN ships in a night surface action utilizing the advantage of US radar. Admiral Lee's fast battleships had been detached from their carrier escort roles and assembled into a circular steaming formation (see NVG 169: *US Fast Battleships 1936–47*) in preparation for line-of-battle formation when the Mobile Fleet was located. This battleship "gun line" was positioned 15 miles to the west of the carriers, and nearest to the enemy, to provide a wall of AA fire through which any Japanese carrier aircraft would have to fly to attack US carriers. Admiral Mitscher's disposition for the battleships, as a vanguard to his carriers, echoed



One of two shell decks, where armor piercing and high explosive shells are stored. The shell hoist, with the controls, is between the different shells. These shell decks are located beneath the turret machinery decks, and above the magazine. (Author's collection)

Admiral Ozawa's own vanguard. Admiral Mitscher signaled Admiral Lee: "Do you seek night engagement? It may be we can make air contact late this afternoon and attack tonight. Otherwise we should retire eastward tonight." Admiral Lee responded: "Do not (repeat not) believe we should seek night engagement. Possible advantages of radar more than offset by difficulties of communication and lack of training in fleet tactics at night. Would press pursuit of damaged or fleeing enemy, however, at any time." Two major factors weighed on Admiral Lee's mind. One was his previous experience of night battle off Guadalcanal on November 15, 1942, when he lost two destroyers and the USS *South Dakota* had been badly damaged during a melee with two Japanese cruisers. Even though Admiral Lee, in USS *Washington*, had sunk the Japanese fast battleship *Kirishima*, he had not been certain of the position of *South Dakota* relative to *Washington*, and had been faced with the possibility of firing on his own ships. His second major concern was that the continuous carrier escort duties of his fast battleships had precluded any opportunity for training his battleships in night line-of-battle actions. Additionally, nighttime tropical atmospheric conditions could interfere with ship-to-ship communications.

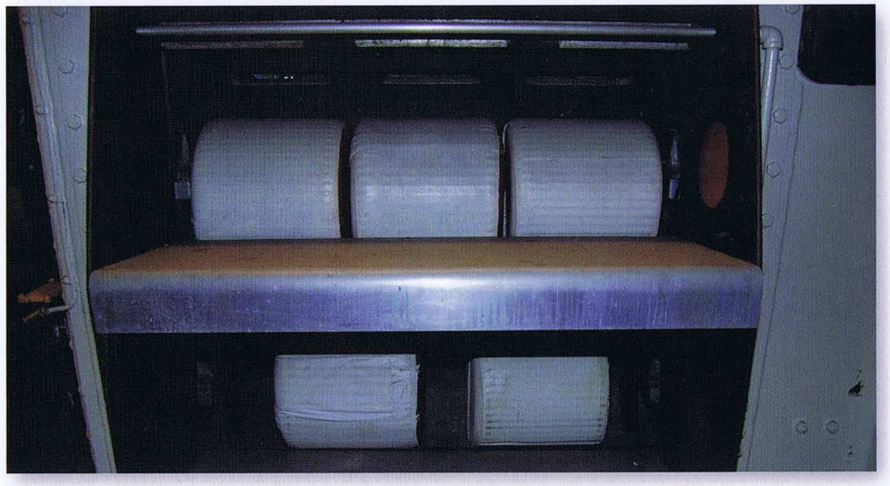


Looking down into the powder handling room. Powder charges are brought into the room from the annular space via the scuttles in the bulkhead. Two scuttles are visible. The charges are then placed in the hoist, the fitting with the red top, which is fixed to the revolving structure and raised to the gun house. (Author's collection)

As a result of Admiral Lee's response and as required by Admiral Spruance, commander of Fifth Fleet, to keep Task Force 58 close to the Mariana Islands to protect the invasion force, Admiral Mitscher withdrew Task Force 58 eastward to await the onslaught of Japanese carrier aircraft from Admiral Ozawa's Mobile Fleet. This came on the morning of June 19, 1944, when Ozawa launched an air armada larger than the first wave of Japanese aircraft that had struck Pearl Harbor in December 1941. However, this time the radar-vectored Hellcats of Task Force 58 carriers met the Japanese planes well before they reached US ships, and what came to be known as the "Marianas turkey shoot" began. In addition to losing 244 carrier aircraft and their crews, Admiral Ozawa also lost two fleet carriers, *Taiho* and *Shokaku*, sunk by the submarines *Albacore* and *Cavalla* respectively. Admiral Mitscher launched his aircraft against the Mobile Fleet late in the day on June 20, and sank the carrier *Hiyo*. Six IJN carriers survived the battle together with the battleships. There was concern within the US Navy that a great opportunity to destroy the IJN fleet had been missed, but this concern was counterbalanced by the fact that the seaborne invasion of the Marianas had not been defeated by the IJN. The IJN ships that had been able to escape would, however, play a significant role in the battle of Leyte Gulf four months later.

The Battle of Leyte Gulf

Having failed to achieve a "decisive" battle in the Philippine Sea, IJN Command recognized that if US forces captured the Philippine Islands they would cut off Japan from the oil and raw materials produced in the captured East Indies, vital to its war economy. Interdiction of this supply route by US submarines had already resulted in IJN battleships having to be stationed in Lingga Roads, off the island of Sumatra and close to the Palembang oil fields, rather than in Japan. On October17, 1944, US forces landed on the island of Homonhon in the Philippines in order to secure the sea passage to Leyte Gulf for the invasion force. This triggered the sailing of Admiral Kurita's First Striking Force from Lingga Roads on October 18, with seven battleships. After refueling in Brunei, this force was split into two components. Admiral Kurita, leading five battleships including *Musashi* and *Yamato*, planned to approach Leyte Gulf through the San Bernardino Strait. Admiral Nishimura, with two battleships, was to approach Leyte Gulf through the Surigao Strait, being joined by Admiral



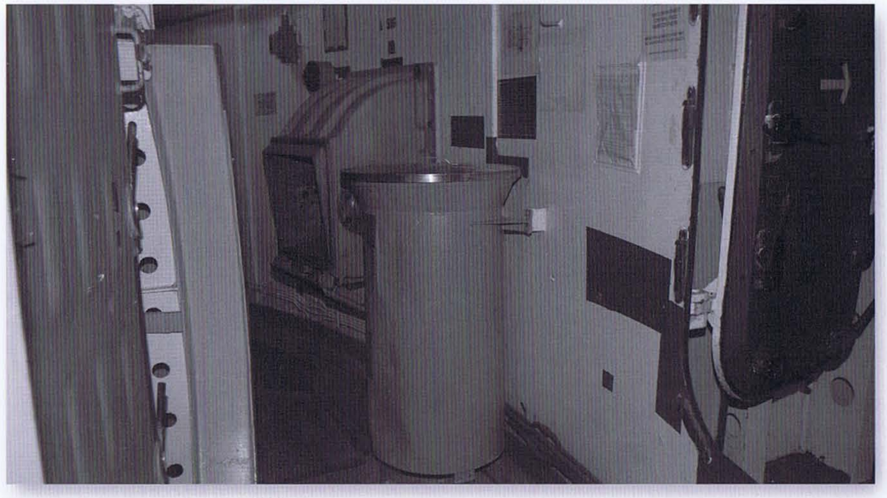
Powder charges placed in the powder handling room hoist. Five powder bags are used for a reduced-charge firing, and six for a full charge. The red disc on the wall of the hoist indicates where the corresponding red disc on the charge, which contains the igniter, is to be positioned to help speed up reloading. (Author's collection)

USS *Missouri* firing from Turret 2. Note Spot 1 turned to starboard directing fire. (Naval Historical Center)

Shima with his cruisers and destroyers. The objective for the IJN was to attack the invasion force in Leyte Gulf and cut off US troops from supplies and reinforcements. Admiral Ozawa, with four carriers and two hybrid battleship–carriers, sailed south from the Inland Sea towards the Philippines. His purpose was to draw the Third Fleet, commanded by Admiral "Bull" Halsey, northwards, and thereby leave the San Bernardino Strait uncovered for Admiral Kurita's force to reach Leyte. Admiral Ozawa's carriers had 116 aircraft available for combat, three-quarters of their normal complement. Furthermore, the pilots manning these aircraft were new to carrier and combat operations. Admiral Ozawa, aware that his carriers were no longer a match for those of the US, was willing for his carriers to act as a sacrificial decoy.

As a result of decisions made by President Roosevelt, there was split command of the two US naval forces (the Seventh Fleet and Third Fleet) assigned to the invasion of Leyte. General MacArthur, as overall commander for the invasion of the Philippines, had the Seventh Fleet, led by Admiral Kinkaid, under his direct command. Admiral Kinkaid had a bombardment and fire support force of six modernized pre-1922 battleships and 18 escort carriers for local air support, and was responsible for the naval component of the invasion of Leyte Island. Admiral "Bull" Halsey reported to Admiral Nimitz, located in Pearl Harbor, and was responsible for "cover and support forces of the Southwest Pacific (MacArthur) in order to assist in the seizure and occupation of objectives (Leyte) in the Central Philippines." The Third Fleet was to "destroy enemy naval and air forces in or threatening the Philippine Area." A separate and subsequent order to Halsey stated: "In case opportunity for destruction of major portion of the enemy fleet offer or can be created, such destruction becomes the primary task." This order was issued to prevent another missed opportunity occurring, as was thought to have happened when Admiral Spruance ordered Admiral Mitscher to bring Task Force 58 back to cover the invasion of the Marianas on June 18. Halsey had 17 fast carriers and six fast battleships, including *Iowa* and *New Jersey*, available in his command. Halsey had raised his flag on the *New Jersey*.

During the day of October 24, 1944, carrier aircraft from Halsey's Third Fleet located Kurita and Nisimura's forces. Initial carrier air attacks were made on Nishimura's force, and then on Kurita's force sailing eastward through the Sibuyan Sea towards the San Bernardino Strait. The *Musashi* was sunk after being hit by at least 17 torpedoes and 19 bombs, and Kurita withdrew to the west. When Ozawa's carriers were sighted late in the day at 1640hrs, Halsey recognized that the long range of IJN aircraft coupled with bombs and torpedoes made them a more formidable threat than the four battleships left in Kurita's fleet. "Bull" Halsey was following the later part of his orders from Admiral Nimitz regarding the "opportunity for destruction of major portion of the enemy fleet."US Naval High Command did not know that the IJN's carrier combat capability had been significantly degraded by combat losses and lack of new aircrew training. Accordingly, Halsey took the



The annular space between the powder handling room and the magazine. Charges from the magazine enter via a scuttle in the bulkhead, behind the gray cylinder, and then pass through another scuttle into the powder handling room. The gray cylinder is a ready container for any broken or smoldering charges that need to be isolated. It is this space which possibly saved *Iowa* from exploding, by containing the explosion within the powder handling room. (Author's collection)

Third Fleet north, and sailed through the night to be in a position by dawn to launch a powerful attack on the IJN carriers. At this point, the lack of an overall naval commander for the Seventh and Third fleets, together with General MacArthur's requirement that all radio traffic from Kinkaid to Halsey be routed through his radio station in Manus, produced confusion as to which naval forces were to guard the San Bernardino Strait – with the result that it was left uncovered. Significant delays occurred in the Manus radio station before Kinkaid's messages were retransmitted to Halsey. Kurita turned his force to the east and was able to pass through the San Bernardino Strait unmolested during the night of October 24. He then steered south towards Leyte Gulf as daylight broke.

During the night of October 24, Nishimura steered his ships into the Surigao Strait and into a cauldron of torpedoes launched by Seventh Fleet destroyers and shells fired by six battleships and accompanying cruisers. Both battleships were sunk and Nishimura's one surviving ship withdrew to meet Admiral Shima, who had been following behind. Shima also reversed course to avoid the deathtrap of Surigao Strait.

As Kurita sailed off Samar Island towards Leyte Gulf at 0645hrs on October 25, he encountered Task Unit 77.4.3 comprising six escort carriers, three destroyers and four destroyer escorts, referred to as Taffy 3. The escort carriers and their aircraft were tasked for antisubmarine patrol, air combat, and to support ground troops, and therefore they carried a minimal supply of torpedoes and armor piercing bombs. For the next two hours, in the battle off Samar, these 13 ships and their aircraft, plus aircraft from Taffy 2 carriers, held off the might of Kurita's force – battleships *Yamato*, *Kongo*, *Haruna*, and *Nagato*, plus six heavy cruisers, two light cruisers, and 11 destroyers.

The destroyer USS *Heermann* engaged the battleship *Haruna* in a gun duel firing 260 5-inch shells at ranges between 4,000 and 8,000 yards, and secured a torpedo hit on *Haruna*'s stern. Additionally, *Heermann* forced both *Yamato* and *Nagato* to turn away from Taffy 3 to avoid *Heermann*'s spread of torpedoes.

The destroyer USS *Johnston* emerged from a smokescreen and confronted *Kongo* at a range that decreased to 5,000 yards. Having already been hit three times by 14-inch shells from *Kongo*, USS *Johnston* opened rapid fire with 30 5-inch shells in 40 seconds, which resulted in 15 hits on *Kongo*'s superstructure tower. *Kongo*'s return fire of 14-inch shells passed over *Johnston* because the fast battleship could not sufficiently depress her guns.

Part of the magazine with powder charges in their storage containers. (Author's collection)

In this uneven battle, Taffy 3 lost one escort carrier, *Gambier Bay*, two destroyers, *Johnston* and *Hoel*, and the destroyer escort *Samuel B. Roberts*. The escort carrier *St. Lo* was hit after the battle by a kamikaze aircraft and also sank. However, the 5-inch guns of the escort carriers, destroyers, destroyer escorts and their torpedoes, plus aircraft attacks, all combined to sink the IJN cruisers *Chokai*, *Chikuma*, and *Suzuya*. At approximately 0911hrs Admiral Kurita ordered his forces to break off the action, cancelled the proposed move south to Leyte Gulf, and returned to the San Bernardino Strait.

Prior to and during the battle, messages from Kinkaid to Halsey had been held up in Manus. When they were finally received, Halsey ordered Task Force 38.1 with five carriers and four cruisers to aid Taffy 3. Aircraft from these carriers arrived at approximately 1316hrs to attack Kurita as he was steaming north for the San Bernardino Strait. A message from Admiral Nimitz to Halsey at 1000hrs, asking the whereabouts of Task Force 34 with the six fast battleships, prompted Halsey to order them south towards the San Bernardino Strait and Taffy 3. *New Jersey* and *Iowa*, using their greater speed, sailed ahead of *Alabama*, *Massachusetts*, *South Dakota*, and *Washington*. *New Jersey* and *Iowa* arrived off the San Bernardino Strait three hours after Kurita and the battleships *Yamato*, *Kongo*, *Haruna*, and *Nagato* had entered the Strait on their return to Brunei. The "decisive" battleship battle was not to be.

Admiral Halsey has been criticized for leaving the San Bernardino Strait uncovered and thereby putting Taffy 3 and the invasion force in Leyte Gulf at risk. Admiral Kinkaid has also been criticized for not deploying search aircraft north from Leyte Gulf to the San Bernardino Strait and thereby being surprised by Kurita. These arguments have complex backgrounds founded in the decision to have a split naval command and in not allowing Fleet commanders to communicate directly.

Despite the focus on the San Bernardino Strait being left without cover, Admiral Halsey's Third Fleet Task Force 38.3 and 38.4 continued north, and attacked Admiral Ozawa's force on October 25 in the battle of Cape Engano, sinking all four carriers. This was the greatest number of IJN carriers sunk in one day, greater than that at the battle of Midway in June 1942. This left the IJN with only seven carriers remaining in commission, two of which were only used for ferrying aircraft, one that had no aircraft, and two that never sailed. Taken together, the battle of the Philippine Sea destroyed the IJN carrier aircrews, while the battle of Cape Engano destroyed the last of the IJN carriers capable of combat operations. Additionally, the *Musashi* and two other IJN battleships had been sunk.

Fleet Admiral Nimitz, who directed the Pacific naval war from Pearl Harbor, signing the Japanese surrender document on board USS *Missouri*, with General MacArthur and admirals "Bull" Halsey and Forrest Sherman looking on. (Naval Historical Center)

The need to counter the Kongo class had been a major determining factor for the General Board of the US Navy to build ten fast battleships of the North Carolina, South Dakota, and Iowa classes. It was an irony of war that two ships of the Kongo class, *Kongo* and *Haruna*, battled two Fletcher class destroyers, *Heermann* and *Johnston*, which displaced 2,770 tons. It was these destroyers with their 5-inch guns and torpedoes that hit and turned the battleships away.

It is a further irony that the IJN quest for a "decisive" battleship battle would result in a battle with US escort carriers, destroyers, and destroyer escorts. These small ships and their aircraft would defeat four IJN battleships and sink three cruisers. One Taffy 3 sailor was heard to say as the IJN ships turned away: "Damn it boys, they're getting away!"

The Big "What If"

What if *Yamato* and *Iowa* had met in battle? Which would have survived?

There were three situations in which a battle between Iowa class and Yamato class battleships might have occurred. The first would have been if admirals Lee and Mitscher had sailed west during the day of June 18, 1944, for an air attack on Admiral Ozawa's Mobile Fleet followed by a night surface battle. The second would have been if Admiral Halsey had formed Task Force 34 with his six fast battleships and left it to cover the San

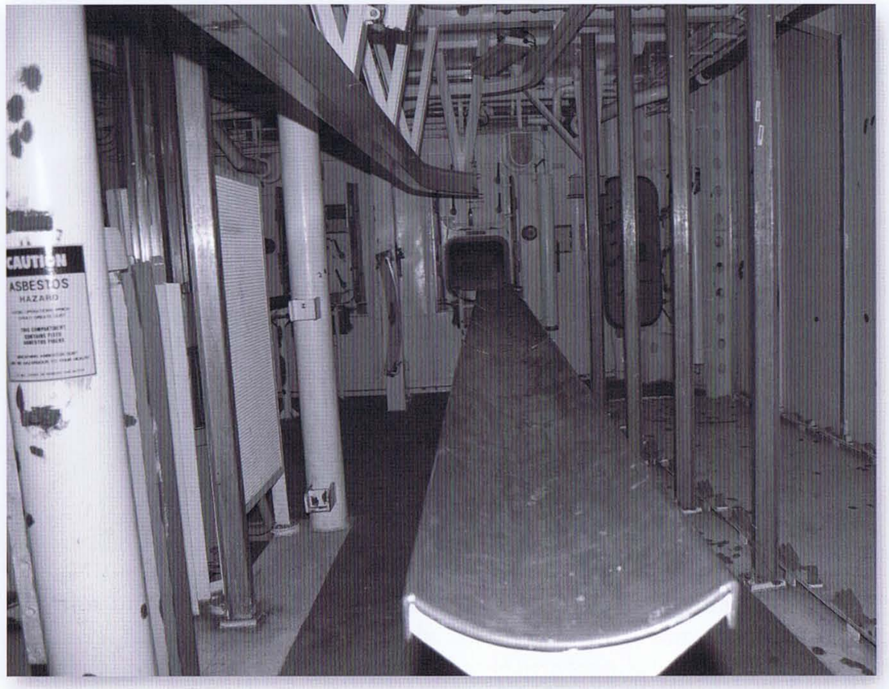
Comparison

	Yamato	*Iowa*
Displacement	62,315 tons	48,110 tons
Speed	27 knots	33 knots
Main armament	9 x 18-inch	9 x 16-inch
AP shell weight	3,200lb	2,700lb
Maximum range	45,000 yards	42,000 yards
Rate of fire	1.5 rounds/minute	2 rounds/minute
Armor – main belt	16.1in	12.1in
Armor – deck (total)	7.8in	7.3in
Armor – turret face	25.6in	19.7in

Armor penetration (by yards)

Armor	*Yamato*	*Iowa*
12-inch	38,300	38,000
16-inch	28,700	28,200
8-inch	35,100	33,600
10-inch	38,300	38,000

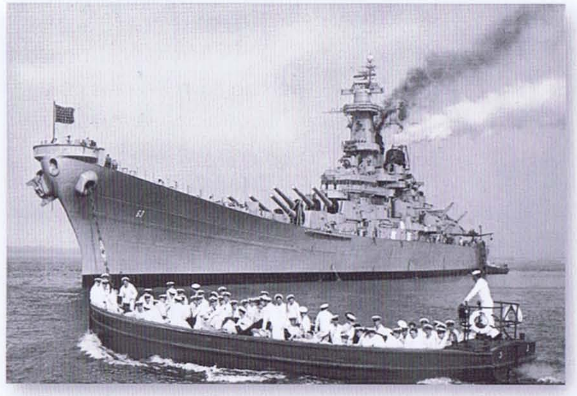
Inside an empty magazine, showing the powder conveyor leading to a scuttle. (Author's collection)



Bernardino Strait; this would have allowed the battleships to engage Admiral Kurita on his exit into the Philippine Sea, which occurred at 0037hrs on the morning of October 25. The third would have been if Admiral Halsey had sailed Task Force 34 south earlier, either on the night of October 24 or dawn on October 25, to meet Admiral Kurita as he sailed north to regain the San Bernardino Strait after fighting Taffy 3.

The first two instances would have been night battles, with the third taking place in the day. For a night battle, the Iowa battleship would have had the distinct advantage of its surface search radar that could detect large ships out to 40,000 plus yards and then bring the Mark 8 fire control radar, with its narrower band width onto target, and have been able to open fire at 40,000 yards. This capability was demonstrated during the opening stages of the battle of Surigao when, at night, USS *West Virginia* detected the battleship *Fuso* at 44,000 yards with Mark 8 radar. During this battle, fire opened at 22,800 yards to conserve armor piercing shells, and hits were made with the first salvoes. While the Yamato class had Type 22 surface search radar that could range out to 38,000 yards, it was not precise enough for long-range gunnery. If an Iowa stayed between 35,000 and 40,000 yards from a Yamato, her shells could penetrate the Yamato's deck armor, and the Iowa's risk of being hit would be negligible. The Iowa had a 5-knot speed advantage over the Yamato, which enabled her to dictate the firing range to her advantage. The issue would have been whether the Iowa could have made a sufficient number of hits at the 35,000 to 40,000 yard range (where firing accuracy was low because of steeply diving shells) to degrade the Yamato's fighting capability. This would have allowed the Iowa to safely decrease the range for greater accuracy, and still have enough shells left to continue to fire on her enemy counterpart.

For a daylight engagement, the US Navy control of the air would again allow an Iowa to open fire at 40,000 yards, using both optical and radar rangefinders and Kingfisher spotting aircraft to control her gunfire. The tactics would have been the same as at night, using the Iowa's superior speed to control the gun range. This would have been critical, as *Yamato* had excellent optical rangefinders and had been able to hit USS *Gambier Bay* at 37,000 yards off Samar. This risk could have been minimized by the Iowa operating behind a destroyer- or cruiser-laid smokescreen and relying on her radar and Kingfisher for spotting.



ABOVE LEFT
USS *Missouri* back in New York harbor to celebrate Navy Day during Fleet Week, October 1945. The destroyer USS *Renshaw* is alongside carrying President Truman. (Naval Historical Center)

ABOVE RIGHT
USS *Missouri* during peacetime, about to take on US Naval Academy midshipmen for their summer training cruise in 1948. (Naval Historical Center)

A major risk for Iowa battleships was that of receiving a shell hit in the superstructure tower where radar control was located. The experience of USS *South Dakota* during the night battle off Guadalcanal on November 15, 1942, showed that hits in this area could significantly degrade a ship's fighting capability. If such an incidence had occurred, the Iowa would have had to rely on her optical rangefinders for fire control, the same as the Yamato, and a slugfest would have ensued. Notwithstanding a loss of radar, the Iowa's Mark 8 rangekeeper with optical range input could compute firing solutions quicker than the Yamato's Type 98 low-angle fire control computer, and was the more effective fire control instrument. Coupled with a higher rate of fire, the Iowa would in all probability have achieved a greater number of hits on the Yamato than she would have received.

Both classes of ship could take significant punishment by shell and torpedo, and continue to operate. However, the most probable outcome would have been that after suffering significant shell damage from an Iowa, the *Yamato* would finally have been sunk by destroyer-launched torpedoes.

As a footnote, in September 1968, USS *New Jersey* steamed over the location of the wreck of the IJN *Musashi* on her voyage to Vietnam.

Post War

Japan formally surrendered unconditionally on September 2, 1945, at a signing ceremony on board USS *Missouri*, anchored in Tokyo Bay. By March 1949, the *Iowa*, *New Jersey*, and *Wisconsin* were decommissioned. *Missouri* undertook a series of midshipman cruises, and sailed in the Mediterranean to deter Soviet Russian advances to Turkey and Greece. She was the only battleship in commission when North Korea invaded South Korea on June 25, 1950, and the Korean War began.

USS *Missouri* ran aground on January 17, 1950, on Thimble Shoals outside Norfolk, Virginia. *Missouri* was eventually freed on February 1. This picture shows tugs attempting to pull *Missouri* free. (Naval Historical Center)

Korean War

USS *Missouri* opened fire on September 15, 1950, bombarding Samchok on the Korean east coast in order to create a diversion for the landings at Inchon on the west coast.

The *New Jersey* was recommissioned in November 1950, *Wisconsin* in March 1951, and *Iowa* in August 1951. All four ships operated in the Korean combat area as detailed below:

Ship	Period	Ship	Period
Missouri	9/1950 to 3/1951	*Iowa*	4/1952 to 10/1952
New Jersey	5/1951 to 11/1951	*Missouri*	10/1952 to 4/1953
Wisconsin	11/1951 to 4/1952	*New Jersey*	4/1953 to 7/1953

While these battleships provided fleet air defense for carriers of Task Force 77, their primary task was shore bombardment for a number of operations: gunfire support of ground forces on the coastal flanks of the battle line; interdiction of coastal rail and road traffic to reduce supplies to enemy troops, with major targets being rolling stock, tunnel entrances, and rail and road bridges; flak suppression in support of air strikes; gun emplacements, enemy troop bunkers and trench systems; and major port facilities and logistical centers.

During February and March 1951, *Missouri* undertook shore bombardments against the following targets:

Target	Number of operations	16-inch shells fired
Shore batteries	22	20
Troops	19	218
Transportation	41	1,167
Shore installations	9	167
Military installations	1	38

The *Missouri* gunfire played a major role in aiding troops on the ground. In one instance near Pohang, *Missouri* came to the aid of an army division

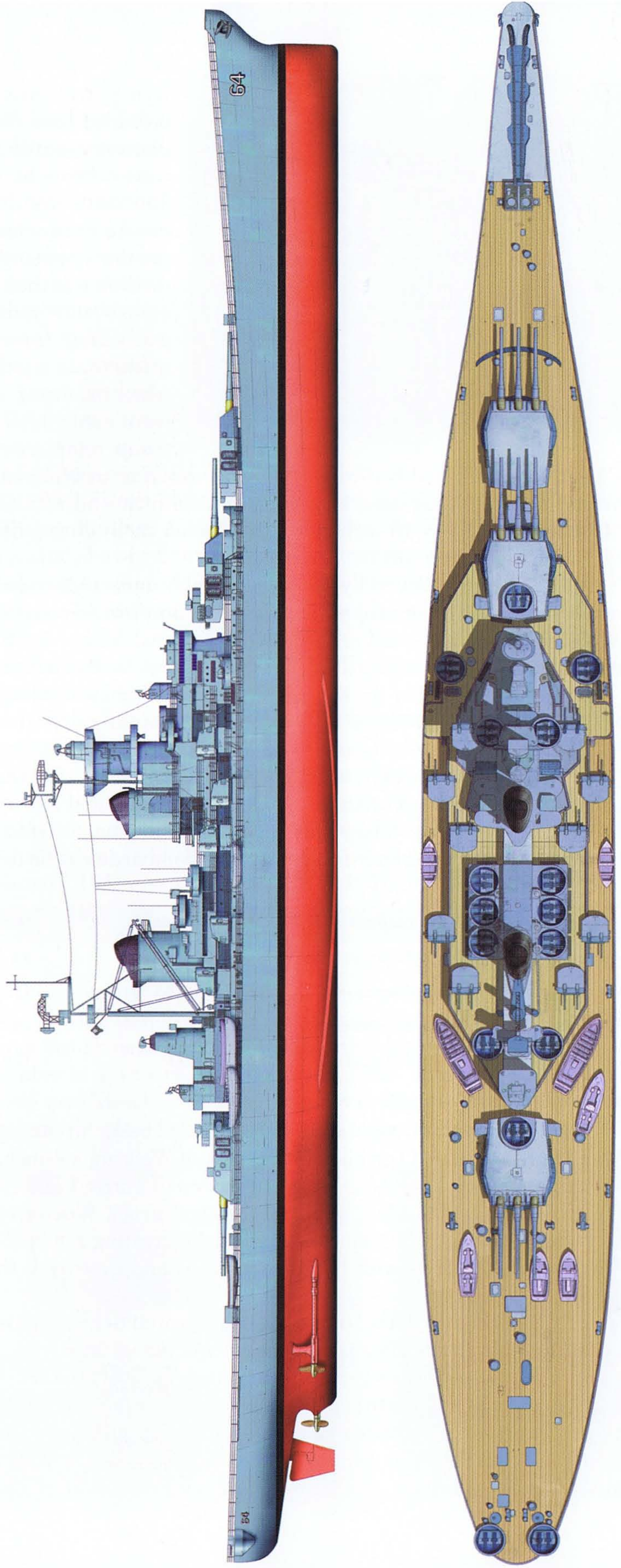
D

USS *WISCONSIN*, AS OPERATIONAL DURING HER ASSIGNMENT TO THE KOREAN WAR ZONE IN EARLY 1952

This profile clearly shows the *Wisconsin* without the 20mm antiaircraft guns, reduced 40mm mounts, and the removal of the two fantail catapults and fixed wing aircraft.

Of particular importance are the radar changes. *Wisconsin* is shown with the SPS-6 air search radar on its foretop. An SG-6 surface search radar is located aft and above the SPS-6 radar. New antennas for ship-to-aircraft and ship-to-ship communications are also visible on the foretop. The mainmast has been braced to the aft funnel and carries a height finding radar. The aft main armament Mark 38 director is now equipped with a Mark 13 fire control radar set, upgraded from the original Mark 8. The improvements in radar and communications antenna allowed the ship to direct air strikes to target areas, as well as to intercept and jam enemy radar and radio transmissions.

The removal of the catapults on the fantail opened up an expanse of deck on which helicopters could alight and be stowed. The use of helicopters for spotting both main and secondary gunfire resulted in improved gunfire accuracy.



USS *Iowa* firing at coastal artillery at Koje, Korea, October 1952. Note that the ship is anchored, and has its number 61 on the roof of Turret 1 and the Stars & Stripes on the roof of Turret 2 for aerial recognition.
(Naval Historical Center)

trying to cross a heavily defended river. With an army observer spotting fire, shells were brought down to 300 yards from the observer, hitting enemy emplacements on the opposing bank. The division was then able to walk across the river. *Missouri* was firing from nine miles offshore. In another incident, when the Army and Marines were confronted by Chinese troop reinforcements at the Chosin Reservoir and had to withdraw to the coast at Hungnam, *Missouri* helped hold off their attackers with 162 16-inch and 699 5-inch shells. *Missouri* fired 2,895 16-inch and 8,043 5-inch shells during her September to March assignment off the Korean coast.

Missouri was relieved by *New Jersey* who undertook missions against railway transport. The battleships found that only armor piercing shells were effective in the bombardment of a train tunnel, either by breaching its structure, or causing a landslide of earth and rock to block its entrance.

During the period of the Korean War, the battleships fired 20,424 rounds of 16-inch shells. As shore bombardment required external spotting, the battleships used ground observers and helicopters carried on their fantail (their catapults and aircraft had been removed in 1949). The ships also used carrier aircraft, but accuracy was higher with dedicated and trained aerial spotting crews. *New Jersey* recorded the following differences between helicopter and aircraft spotting during 119 bombardment firings:

Spotting method	Salvoes/Rounds fired	Bridges	Other targets
Helicopter	No. of salvoes per first hit	4.0	3.3
	No. of rounds fired	12.0	13.3
Aircraft	No. of salvoes per first hit	6.1	3.8
	No. of rounds fired	27.6	17.9

There were only two instances of battleships being hit during the Korean War. On May 20, 1951, while off the coast of Wonsan, a 4-inch shell from a shore battery struck the *New Jersey* on the top of Turret 1 and exploded with minimal damage. On March 15, 1952, a shell struck *Wisconsin* on 02 deck starboard side between frames 144 and 145, creating a hole 24in by 30in. *Wisconsin* responded with her 16-inch guns and destroyed the offending artillery battery.

The 16-inch guns of the Iowa battleships proved to be the most destructive guns available to the US and UN troops in combat in Korea. The 16-inch guns could fire further inland than the 8-inch guns of cruisers. Additionally, by being able to sail north of the front line they were able to fire on reverse slope enemy emplacements that army artillery could not reach. As an all-weather and 24-hour capability, naval gunfire could be called upon when aircraft could not fly.

Post Korea

New Jersey left Korea in July 1953 and the Iowas reverted to peacetime training, exercises, and "showing the flag" programs. Korea had clearly shown that jet-age combat made the 40mm Bofors gun obsolete and the 20mm cannons were also removed. The replacement program of 3-inch/50 and 70 caliber AA guns was proposed but they were never installed. Three members of the Iowa class, *Iowa*, *New Jersey*, and *Wisconsin*, had their Turret 2 magazine modified in 1956 to hold Mark 23 16-inch shells containing a nuclear explosive device. The magazine modification included a shell handling room where the arming device could be fitted into the shell prior to firing. An overhead monorail on the third deck allowed the crew to move the nuclear shells to the other two magazines. Dummy Mark 23 shells were also produced for test and spot firing. *Wisconsin* fired a dummy nuclear shell in 1957. The Mark 23 shells were scrapped between 1961 and 1962.

USS *Wisconsin* at sea in 1952. *Wisconsin* served on the gun line off the Korean coast from November 1951 through to April 1952.
(Naval Historical Center)

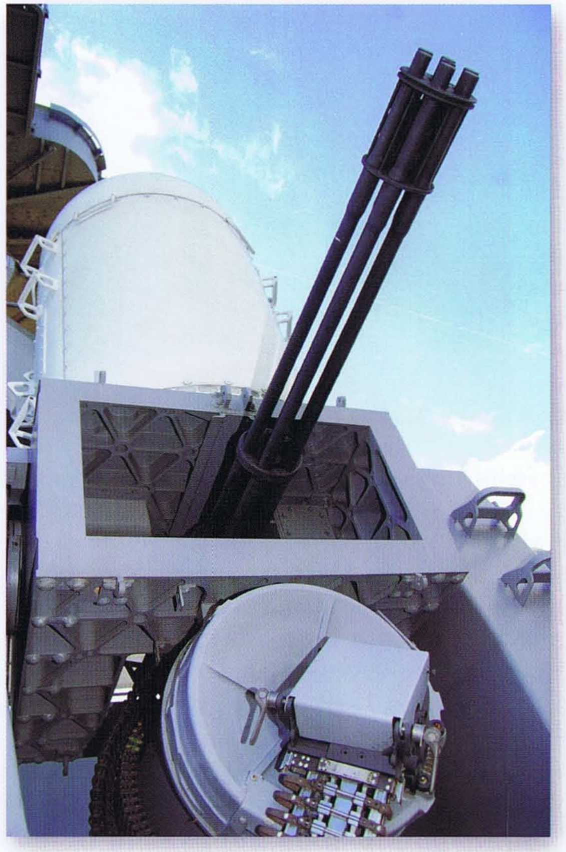
On May 6, 1956, *Wisconsin* collided with the destroyer USS *Eaton* off the Virginia coast, and severely buckled its bow. The bow of the incomplete Iowa class *Kentucky* was removed and the 68ft section welded onto *Wisconsin's* hull, enabling the ship to return to sea on June 28, 1956. However, the focus on massive nuclear response for US defense strategy left no place for battleships, and the Iowas were once again decommissioned: *Missouri*, February 1955; *New Jersey*, August 1957; *Iowa*, February 1958; *Wisconsin*, March 1958.

Vietnam

In 1964, as the intensity of the Vietnam War increased, the US Navy considered reactivating two Iowa class battleships. However, internal Navy dissension from senior naval aviators held up the decision until July 1967, when approval was given to reactivate the *New Jersey* only. Between September 1967 and March 1968 *New Jersey* was refitted, with many spare parts being taken from *Iowa* and *Wisconsin*. A major upgrade was made to

BELOW LEFT
USS *Iowa* entering Pearl Harbor in October 1952, with her sides manned, at the end of her deployment to Korea.
(Naval Historical Center)

BELOW RIGHT
USS *New Jersey* firing a single 16-inch shell off the coast of Vietnam during 1969. Note that the ship is steaming very slowly. Spot 1 is not being used for this shot as it is looking forward, with the firing being controlled either by helicopter, ground observer, or a radar fix against a known fixed point.
(Naval Historical Center)



The Phalanx 20mm close-in weapon designed to destroy attacking missiles and aircraft. This modern Gatling gun fires depleted uranium shells aimed by radar at a rate of 4,500 rounds per minute with a kill range of 6,000 yards. The white dome contains the radar and aiming mechanism. (Judi Burr)

the fire control system by the addition of a Mark 48 shore bombardment computer. Previously, shore bombardment had been controlled by manual calculations from a navigational and bombardment chart and then input into the rangekeeper, rather than having input from the optical and radar rangefinders. The Mark 48 used radar and directors to track a known navigational reference point and provide an accurate ship's position. The target was plotted onto a bombardment chart and then entered into the Mark 48 computer, which calculated range and bearing as well as target height. This input was transferred to the rangekeeper for inclusion with ballistic detail to calculate turret train and gun elevation. Other upgrades included electronic counter measures against missiles and chaff launchers, improved communications equipment in HF, VHF, and UHF bands, and an improved helicopter landing pad.

In pre-commissioning trials with a six-hour high speed run, *New Jersey* logged 35.2 knots against her designed 1943 top speed of 33 knots, a testimony to her 25-year-old boilers and turbines. *New Jersey* was

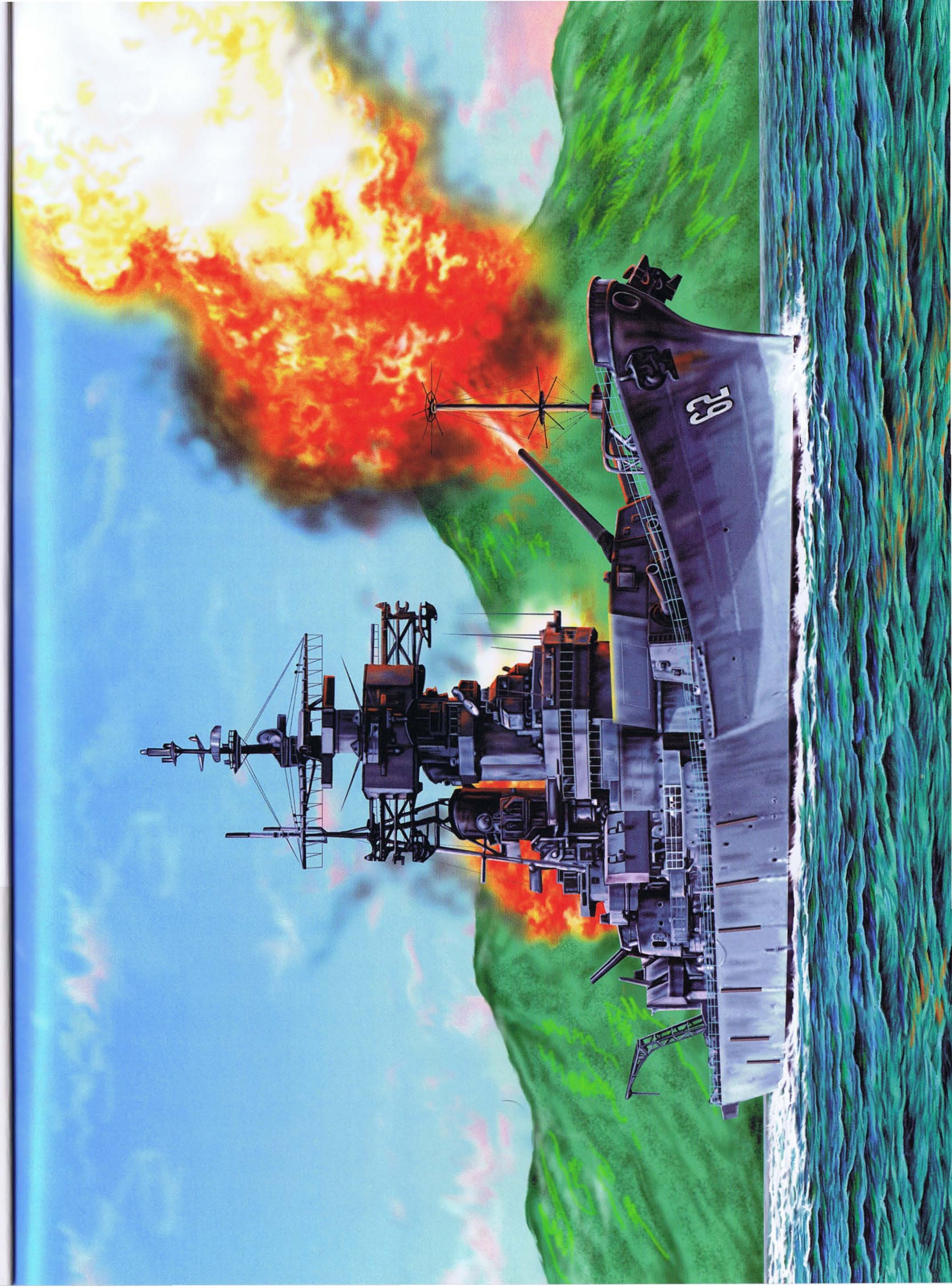
E

ON THE FIRING LINE

On September 30, 1968, *New Jersey* took up position on the gun line off the Demilitarized Zone of the Vietnam coast, and opened fire on communist gun and supply positions. This was the first time in 16 years that *New Jersey* had opened fire in battle (since truce had been declared in the Korean War).

The accuracy and power of *New Jersey*'s 16-inch gunfire was demonstrated on the afternoon of October 29, 1968. The aerial observer located an enemy artillery position on a hilltop about four miles southwest of Cape Lay. The site was active and had been harassing allied ground troops. After *New Jersey* fired four 16-inch rounds, the spotter radioed back "excellent coverage … keep them coming." Two rounds later the radio crackled once again. "You've just lowered the mountain by twenty feet. Artillery site destroyed."

The *New Jersey* could also fire in bad weather. On January 8, 1969, the battleship was four miles offshore enveloped in thick fog. An observer located a defended bunker complex. The ship's weapons officer couldn't see the shoreline but the fire control radar was locked onto a reference point, and the spotter could see well enough to adjust gun strikes. *New Jersey* fired simultaneous 5-inch and 16-inch salvoes and destroyed the four defended bunkers.



recommissioned on April 6, 1968, and opened fire on North Vietnamese forces on September 30 that year. *New Jersey* remained in the Vietnam combat zone until March 30, 1969, and then returned to Long Beach for new crewmembers and a refit. The ship was scheduled to return to Vietnam in September, but instead was scheduled for decommissioning, which took place in December 1969. In a Senate debate in 1981 it became known that the *New Jersey* was withdrawn from service off Vietnam to appease North Vietnamese negotiators in order to progress to a peace agreement. The *New Jersey* was such a powerful and destructive weapon, more so than aircraft, that the North Vietnamese required her to be withdrawn before negotiations could proceed.

Approximately 85 percent of both South and North Vietnam was within range of the 16-inch guns of *New Jersey*. Her effectiveness can be seen from the following:

Gun damage assessment, September 1968–March 1969

Target	16-inch/50 caliber	5-inch/38 caliber
Structures destroyed	439	56
Structures damaged	259	92
Bunkers destroyed	596	59
Bunkers damaged	250	73
Artillery sites destroyed	19	2
Automatic weapons/AA silenced	35	6
Secondary explosions	130	46
Roads interdicted	26	-
Meters of trench line destroyed	1,925	-
Caves and tunnels destroyed	75	-

The support fire given to US troops in action was just as important. One such example occurred when a Marine outpost of 20 men came under attack by a significantly larger force at night. The naval gunfire liaison team with the Marines, led by Lance Corporal Clouse, called in naval gunfire and *New Jersey* responded with 1,710 5-inch shells fired over six hours. The exploding shells established a circular defense around the Marines, who survived the encounter. In another example, the 3rd Marine Division was advancing against a heavily defended bunker complex when *New Jersey* came to its assistance. An eyewitness reported:

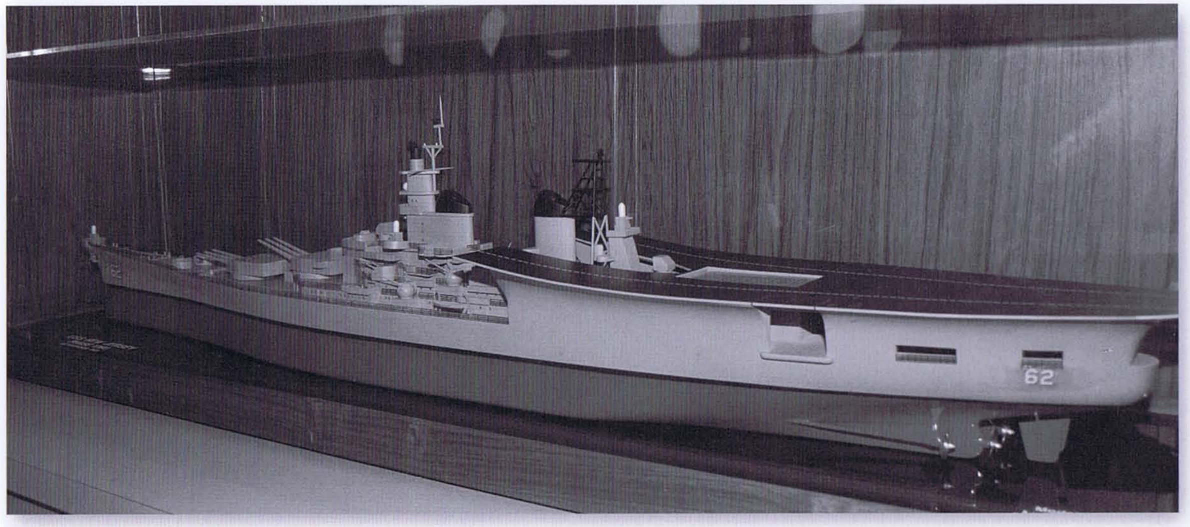
> We were ordered to pull back about 200 yards so that somebody, we didn't know who at the time, could start shooting at some communist bunkers and emplacements that had been giving us a lot of trouble. When we finally moved back about 500 yards, we heard what at first sounded like a subway train moving through a tunnel – a big rushing noise – then BANG! Later on when we went back into the area, there was nothing ... just nothing. It was like something had come along with a big eraser and wiped everything clean. And they were big, heavily fortified bunkers, targets our own artillery couldn't touch.

In total, *New Jersey* fired 5,866 16-inch shells and 14,891 5-inch shells during her Vietnam deployment. Both the Marines and the Army attested to the accuracy, timeliness and effect of *New Jersey*'s gunfire.

Prior to sailing to Vietnam, a detailed evaluation of *New Jersey*'s trial gunfire by the Navy identified occasional full-charge wild shots, where a shell would land either over or short of the target by 1,187 yards. A reduced-charge wild shot would be over or short by 312 yards. In undertaking bombardment operations, *New Jersey* had to ensure that no friendly troops were in the area of exploding shell lethality. A Mark 25 radar was used to measure the initial velocity of every shell fired commencing December 1, 1968. The longer *New Jersey* was on station off Vietnam, so the incidence of wild shots marginally increased. When reduced charges were used in firing, it was found that the incidence decreased. *New Jersey* therefore shifted its target emphasis to reduced-charge firings. An examination of propellant charges used in firing revealed that the powder for reduced charges was produced in 1968, whereas full-charge powder was produced in 1953. As a result, two powder lots were removed from the ship. However, wild shots still occurred, and it was not until after 1984 that the problem of wild shot dispersion was solved.

The Cold War and a Soviet Challenge

By 1964 the Soviet Navy had grown a blue-water global capability, with ships, maritime aircraft, and submarines. By the late 1970s, the Soviet Navy had 1,700 ships in service, compared to 479 in the US Navy, and thereby threatened US maritime supremacy. Of particular importance was the launching in 1977 of the nuclear-powered battlecruiser *Kirov*. At 24,000 tons, *Kirov* was the largest non-carrier warship built since World War II. She was armed with multiple missile systems and was seen as a major threat to US carrier task forces. Additionally, the fall of the Shah of Iran and the Soviet invasion of Afghanistan in 1979 signaled a growing confrontation between Soviet and US interests. In November 1979, Charles Meyers published an article entitled "A Sea-Based Interdiction System for Power Projection" that summarized a detailed analysis of a bombardment capability comparison between a battleship and a carrier. The analysis showed that a battleship could deliver more tons of explosive more accurately, quicker, cheaper, and over a longer period than a

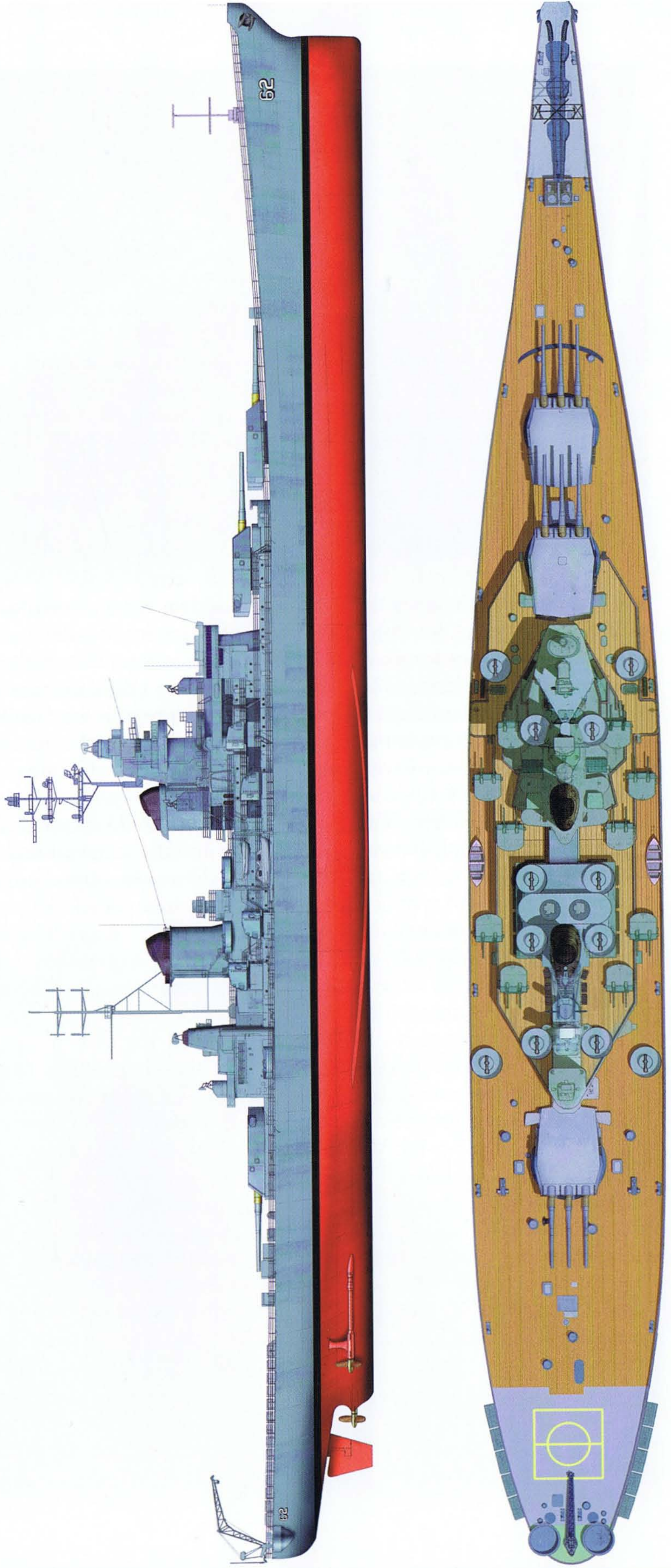


A concept model of a hybrid battleship–carrier, based on an Iowa battleship. The flight deck for VSTOL aircraft splits at the rear superstructure into two ski-jump take-off sections, with an 11-degree elevation. (Judi Burr) carrier. Charles Meyers had been a naval pilot and argued, as an example, that battleship gunfire, rather than the 50 naval aircraft that were actually lost, could have easily destroyed the Thanh Hoa Bridge in North Vietnam.

The election of President Reagan in November 1980, saw the introduction of a new foreign policy to counter the Soviet threat based upon a "we win – they lose" strategy, coupled with a "peace through strength" build-up of the US military. A component part of this policy was to increase the US Navy to 600 ships. While this included the building of nuclear-powered aircraft carriers and attack submarines, Aegis cruisers and destroyers with new missiles, it also saw the return of the four Iowa class battleships. President Reagan's new Secretary of the Navy, John Lehman, pushed the reactivation of the Iowas through Congress and had them armed with Tomahawk cruise missiles, including the nuclear-armed version. The *New Jersey* was recommissioned in December 1982, *Iowa* in April 1984, *Missouri* in May 1986, and *Wisconsin* in October 1988.

The new role for the battleships was to operate with carrier task forces in high threat areas, to operate with escorts but without air cover, to support amphibious operations, to undertake naval gunfire operations, and to "show the flag." In reactivating battleships, three components of what were considered obsolete 40-year-old ships were seen as relevant in a modern context: their survivability, inherent in the armor and large number of watertight compartments with their machinery spaces, magazines, and control compartments below the waterline; their 16-inch guns that could deliver conventional explosives with greater accuracy and penetrating power than airborne bombs or missiles; their endurance and self-sustaining capability, plus the ability to sustain other ships in their task force. Just as important, the battleships could be modernized and recommissioned quickly, and the Soviet Navy had no comparable ship. The Tomahawk gave back to the battleship the range advantage that it had lost to carrier aircraft in World War II. The issue of survivability was demonstrated during the battle of the Falklands when a modern warship, HMS *Sheffield*, sank in May 1982 as a result of an uncontrolled fire, started by the unused fuel from an Exocet missile that hit the ship but did not explode.

To achieve their mission, the Iowas were modernized. Four 5-inch gun turrets were removed, two per side, and the space occupied by the turret



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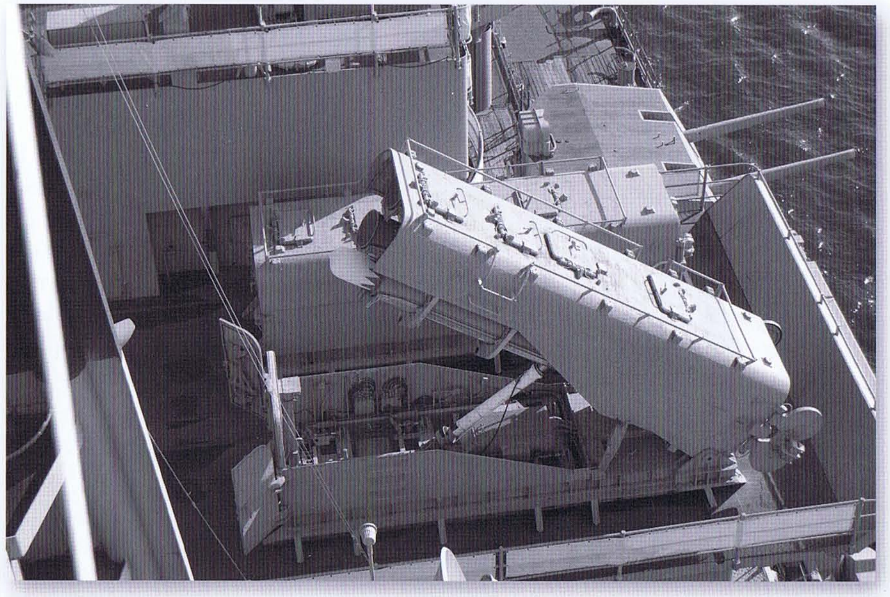
USS *NEW JERSEY* IN 1968 READY FOR SERVICE OFF VIETNAM

This profile shows the development of the Naval Tactical Data System (NTDS) with the large discone cage array located on the foredeck. This NTDS was used for detecting and tracking targets, and selecting the weapon system to combat the target.

Electronic Counter Measure (ECM) equipment was installed to counter any missile threats the ship might encounter off Vietnam. The antennas for the ECM were attached to brackets built out from the sky control platform and were used for target detection and jamming the missile's target acquisition radar. Chaff, to create decoys and false targets for the incoming missile, was fired by Zuni launchers located between the ship's funnels.

The 40mm antiaircraft guns have been removed and four mounts between the two funnels were utilized for the Zuni launchers. Two 40mm mounts on the forward 01 level were converted into swimming pools. A Helicopter landing pad was built on the fantail. The main helicopter used was a Huey, but a drone was utilized for spotting.

Radar was improved with the installation of an SPS-10 surface search radar on the foremast. The SPS-8 radar was removed from the mainmast to make room for additional communications antennas.



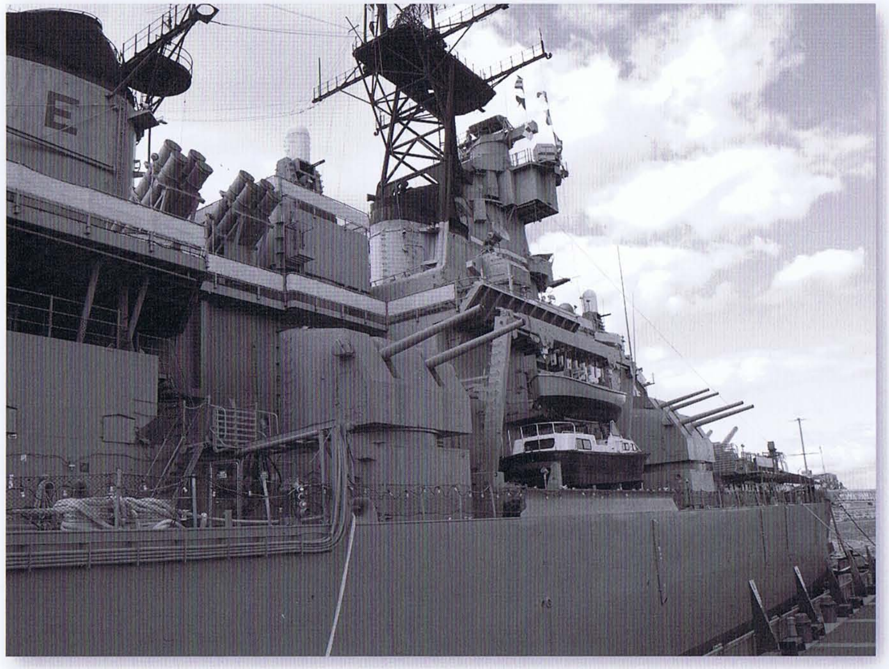
A Tomahawk missile, showing its white nose cone, in one of the eight armored boxes. The missile launches across deck so that the exhaust is vented outboard. It is interesting to note that the 5-inch gun turret behind and below the missile was designed in 1928. (Judi Burr)

barbette provided the entry through the armor deck for the electronic cabling, controls, and pipes for the installation of the new missile systems. The removed 5-inch gun turrets provided deck space for some of the missiles. New equipment included: 32 BGM-109 Tomahawk cruise missiles housed in eight armored box launchers that fired across deck to vent the missile exhaust outboard; 16 Harpoon antiship missiles in four quadruple launchers; four 20mm Phalanx close-in weapon systems, capable of downing incoming missiles; AN/SPS-49 air search radar; and an electronic counter measure system, AN/SLQ-32(V)3. These last two systems could locate and identify incoming missiles and aircraft at 100 miles in automatic operations. The nine 16-inch guns and the Ford rangekeeper could not be improved and were retained. The fuel oil system was modified to marine diesel fuel, so that the battleships used the same fuel as modern navy ships. This required new fuel pumps and renovation of all fuel pipes. A combat engagement center was constructed within the 02 level of the superstructure to control the weapon systems, with the original main battery plots below the armor deck capable of independent operation of the gun batteries if the combat engagement center was rendered inoperative. During the design process for the reactivation of the Iowas, the hybrid battleship–carrier concept reemerged. This concept would have removed Turret 3 and constructed a flight deck over the fantail of the ship for VTOL aircraft, with a hangar beneath, and an aircraft elevator. For take off, the flight deck ended in an 11-degree ski-jump, angled outboard either side of the rear superstructure. However, the US Marines required the support of the full weight of nine 16-inch gun shells rather than more aircraft ordnance, and the concept was dropped.

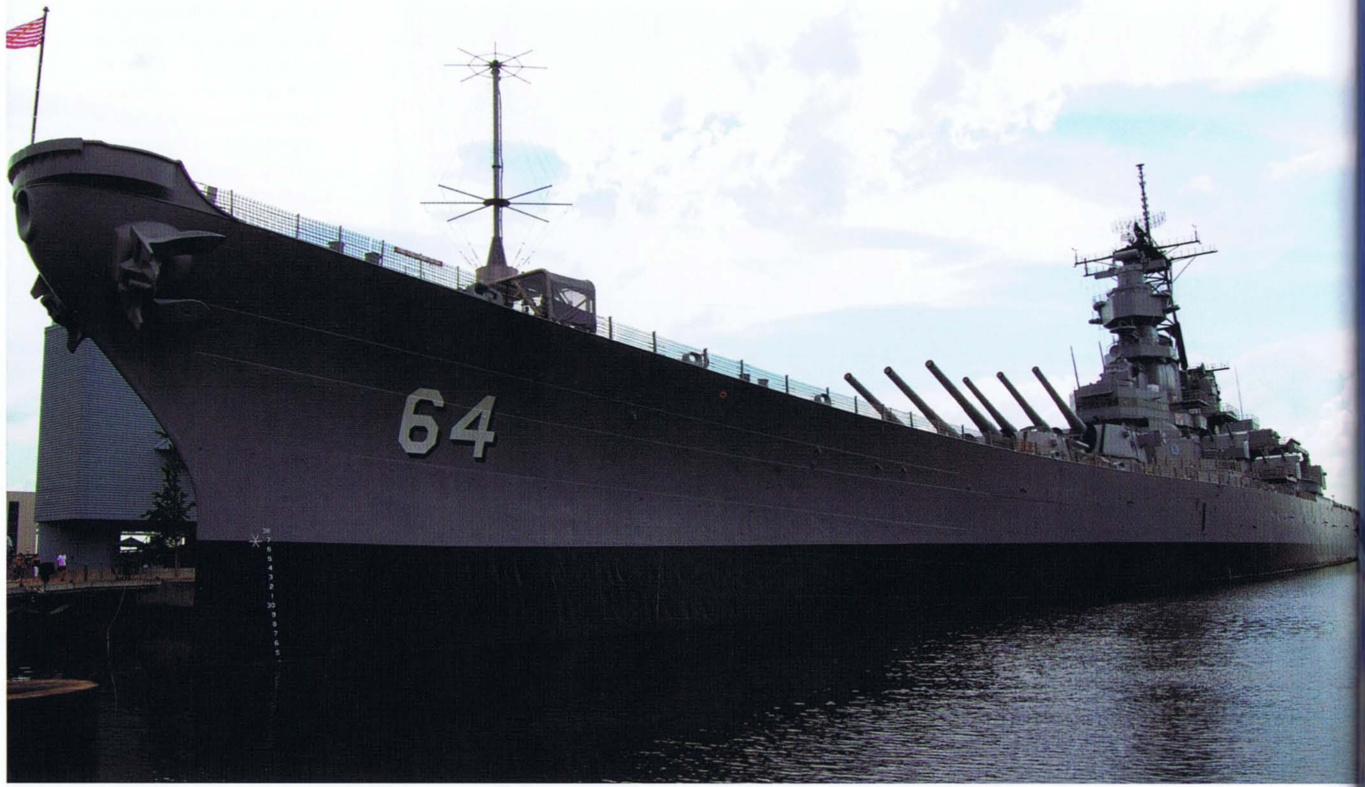
The Iowa battleships operated as Battleship Battle Groups (BBBG) comprising a battleship and an Aegis Ticonderoga cruiser and supporting destroyers with antiship and antisubmarine capability. The BBBG would operate forward of a carrier task force to provide a nuclear-capable threat against surface and shore targets within the range of its 16-inch guns and Tomahawk missiles.

The *New Jersey* was stationed off Lebanon from September 24, 1983, following training cruises in the Pacific. On December 14, she fired eleven 16-inch shells against Syrian AA guns that had shot down two US Navy jets. On February 8, 1984, *New Jersey* fired 270 16-inch shells to destroy Syrian Army artillery batteries and their command center located in the mountains overlooking Beirut, the capital of Lebanon. It was claimed that some of the shells struck civilian areas rather than Syrian Army locations, and this suggested that the wild shot dispersion experienced off Korea was occurring again. Secretary of the Navy, John Lehman, set gunfire guidelines that a salvo of shells had to land within a circle defined by the area of the US Capitol building. The *Iowa* undertook a lengthy series of gunnery trials to eliminate wild shots, and determined they had been caused by a combination of inaccurate initial velocity readings, coupled with inaccuracies in published range tables and in the ballistic cams within the Mark 8 rangekeeper, and powder composition. Doppler velocimeters placed on the middle gun barrel provided accurate initial velocity measurements. New range tables and computers, that tracked stored powder inventory and calculated ballistic measurements based upon gun wear and performance input into the rangekeeper, resulted in increased accuracy for long-range gunfire.

During a gunnery exercise on board the *Iowa* on April 19, 1989, the middle gun in Turret 2 experienced a detonation with 500lb of propellant igniting before the gun breech was closed. Hot gas and flame killed all the men in the turret, and then swept down the turret barbette to the powder handling room, killing the men working in this compartment and igniting powder charges already placed in the hoists for the next salvo. The hatches and scuttles from the powder handling room into the annular space were closed, as were the hatches and scuttles from the annular space to the magazine. This annular space safety feature in all probability saved *Iowa* from being blown up and sunk, as the explosion did not penetrate into the magazine. The crew in Turret 2 magazine initiated the sprinkler system and flooded the magazine, while crews on deck turned fire-fighting hoses on the turret so they could enter and extinguish the raging fire within.



Eight Harpoon missile launchers, with red covers, by the aft funnel. A Phalanx gun is located forward and above the launchers, with a 5-inch gun turret below. (Judi Burr)



Battleship *Wisconsin* berthed at the Nauticus Museum, Norfolk, Virginia. This view shows the 16-inch guns of the two forward turrets, her port side 5-inch turrets, and the massive fire control tower with director, radar, and ECM. (Judi Burr)

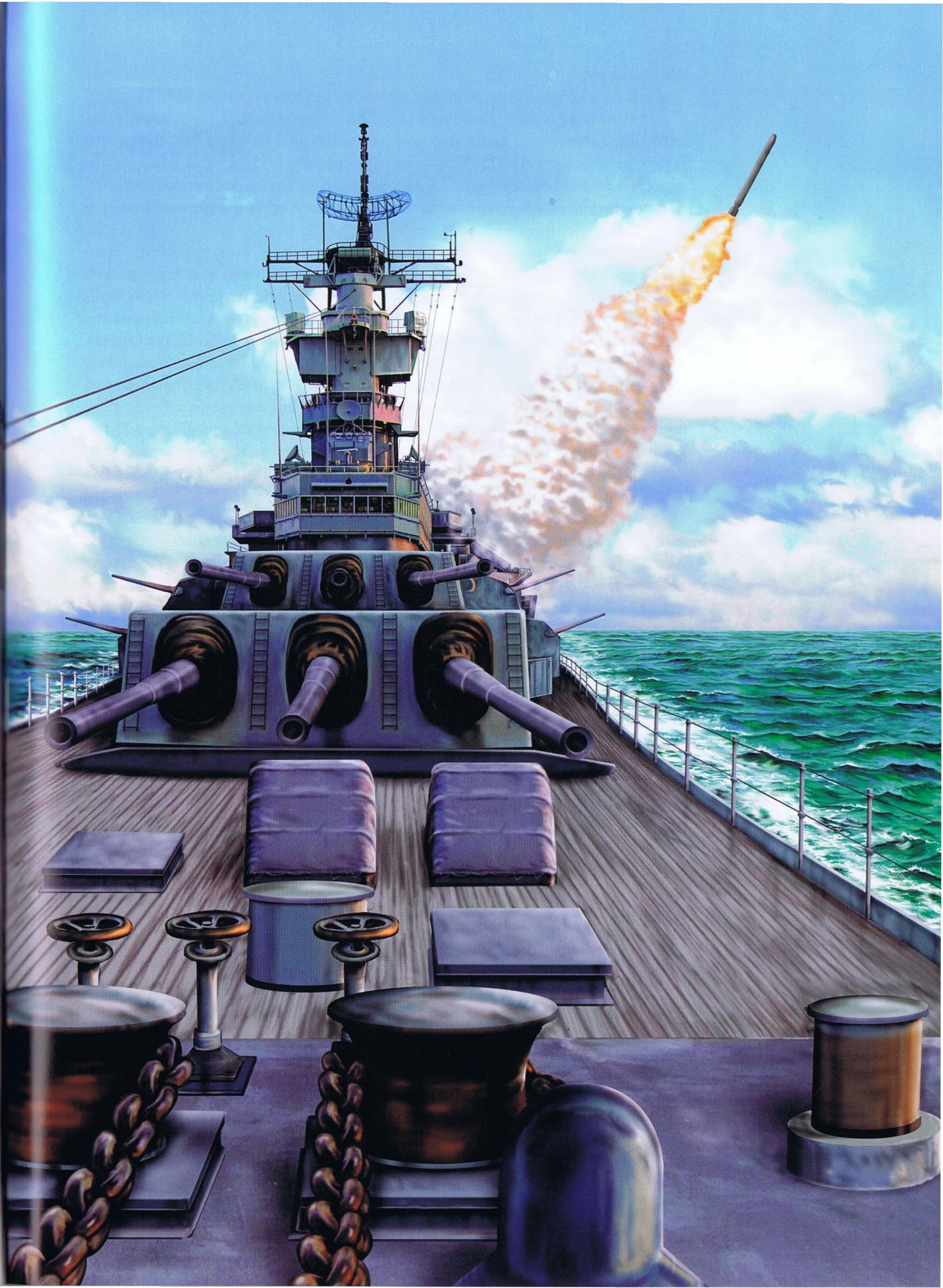
The cause of the explosion in Turret 2 has never been determined. However, following lengthy and detailed reviews by the Navy and Sandia National Laboratories, it is most likely that a combination of factors were involved: inexperienced gun crew; loading an incorrect propellant with a heavy shell; over-ramming the propellant into the gun breech; and a reduced number of trim pellets of tubular nitrocellulose at the end of a powder charge. A mechanism was installed on *Missouri* and *Wisconsin* to provide greater control over the speed of the rammer and the distance it could travel into the gun breech. Additionally, prior to deployment to the Persian Gulf, the powder charges for these two ships were redesigned and the layer of pellets eliminated.

G

DESERT STORM

When USS *Missouri* fired her Tomahawk missiles at targets in Baghdad, a distance of over 330 miles, she gained the reach that aircraft carriers had enjoyed over battleships since the battle of the Coral Sea in May 1942. This had been the first naval battle in which opposing warships did not see each other, and their aircraft, rather than their guns, delivered the destructive ordnance.

In addition to destroying targets in and around Baghdad, the *Missouri* brought her guns to bear and neutralized reinforced ground targets that land-based artillery could not destroy. One nine-gun salvo from the 16-inch guns of an Iowa class battleship was equal in terms of shell weight to the bombardment by 183 155mm artillery pieces (provided such weaponry could be brought onshore in one place to deliver such a weight). In the littoral area, a senior officer stated: "Within the arc of a battleship's guns – war evaporates!" For a heavily armored Iowa battleship the major risk from antiship missiles and fast attack boats was the need for a new coat of paint. While carriers can deliver weapons with pinpoint accuracy to support Marines in an amphibious operation, the rapidly escalating cost of naval aircraft, $192 million for each new F-35C, makes the battleship sound economic in future littoral combat zones.



Post Cold War

The fall of Soviet Russia resulted in a significant thawing in the Cold War and a deterioration of the Russian Navy. As a consequence, the Iowa class battleships were once again decommissioned: *Iowa* in October 1990, *New Jersey* in February 1991, *Wisconsin* in September 1991, and *Missouri* in March 1992. However, two of the battleships were once again able to demonstrate their power in combat before decommissioning took place.

Desert Storm

In the operation to liberate Kuwait from Saddam Hussein and Iraqi forces, *Missouri* and *Wisconsin* were assigned to the battle group in the Persian Gulf. *Wisconsin* acted as Tomahawk Land Attack Missile Strike Commander for the Persian Gulf, and directed the sequence of launches for the 47 Tomahawk missiles fired, commencing at 0140hrs on January 17, 1991. *Wisconsin* fired eight and *Missouri* seven Tomahawk missiles as part of the bombardment of Baghdad and Iraqi air defense and command and control targets. During the night of January 18, *Wisconsin* fired a further 16 missiles and *Missouri* fired 13 (although one missile failed and a replacement was fired in its place). In total, *Wisconsin* directed the launching of 213 Tomahawk missiles. *Missouri* was responsible for coordination of fire support for coalition troops moving against the Iraqi Army and opened fire with her 16-inch guns against Iraqi forces on February 3, destroying command bunkers. For these bombardments *Missouri* flew a Pioneer RQ-2 drone off her fantail for spotting gunfire. The drone relayed video and infrared images of targets and the results of gunfire so that adjustments could be made for greater accuracy. On February 24, *Missouri* commenced shore bombardment of Faylakah Island. This was part of a deception to force Iraqi commanders to believe that the major offensive against them would be an amphibious landing, rather than the planned land offensive from Saudi Arabia. As Faylakah Island was defended by ten Iraqi divisions, the deception was successful, and *Missouri* destroyed significant Iraqi forces after firing 133 16-inch shells. Iraqi forces retaliated by firing two Chinese-made Silkworm missiles, each armed with a 1,113lb warhead, at *Missouri*. HMS *Gloucester*, accompanying *Missouri*, destroyed one Silkworm with her Sea Dart antiaircraft missiles. The other Silkworm crashed into the sea. *Missouri* then destroyed another Silkworm battery with 50 shells from her 16-inch guns. *Wisconsin* joined *Missouri* on the gun line for Faylakah Island, and launched her Pioneer drone for spotting. The drone was flown at a low height over Iraqi troops who, anticipating another bombardment by 16-inch shells, promptly signaled their surrender to the aircraft – the first time troops had surrendered to a drone controlled by a ship. A ceasefire was ordered on February 28. *Missouri* had fired 759 16-inch shells, and 28 Tomahawk missiles. *Wisconsin* fired the last 16-inch salvo (as part of her total expenditure of 319 16-inch shells and 24 Tomahawk missiles) in this operation. Both battleships returned to the US and were then decommissioned.

Iowa Class Battleships Today

Following decommissioning, *Missouri* was berthed at Battleship Row in Pearl Harbor next to the Arizona Memorial and opened as a museum and memorial in January 1999. *New Jersey* also became a museum and memorial in October 2001, and is anchored at the Camden waterfront on the Delaware River. *Wisconsin* was turned over to the Nauticus Museum at Norfolk, Virginia, in December 2009. *Iowa* is moored in Suisun Bay, California, as part of the National Defense Reserve Fleet inventory, awaiting donation to a museum.

CONCLUSION

The Iowa class battleships *Iowa*, *New Jersey*, *Missouri*, and *Wisconsin* were the most powerful battleships available in World War II, as defined by their ability to hit and overwhelm their target. The fire control system with integrated radar gave them the ability to hit first and keep on hitting both by day or night and in all weather conditions, including smoke and fog. While none of the Iowa class engaged in a duel with an enemy battleship, the success of the USS *Washington* in overwhelming and sinking the Japanese battleship *Kirishima* at night, off Guadalcanal in 1942 (see NVG 169: *US Fast Battleships 1936–47*), demonstrated the capability of the radar fire control system developed by the US Navy. All other characteristics of a battleship were secondary to its ability to locate and continually hit its target.

The combination of fast battleship and fast fleet carrier, incorporating radar fire control, massive AA batteries, fighter direction, and the Hellcat fighter, created for the US Navy a war-winning weapon system.

The success of the Iowa design and construction was demonstrated by refits with new electronics and missiles, and the effective operations of the ships until the 1990s, utilizing boilers, turbines, and related machinery, plus main and secondary armament and fire control systems constructed in 1943.

The 1980s' concept of Battleship Battle Groups, armed with nuclear missiles and 16-inch guns, operating in a forward area with carriers in the rear to provide air cover, created for the Soviets a strategic and tactical problem that they could only counter by using nuclear weapons. Instead the Soviets imploded, and their navy rusted into obsolescence.

The weight, accuracy, and sustainability of 16-inch naval gunfire, compared to air-dropped ordnance (as identified by Charles Meyers, and demonstrated off Korea, Vietnam, Lebanon, and Kuwait) made the Iowa class battleship the most feared weapon system in the littoral area, along with a combat-ready US Marine.

Future historians will have to judge whether replacing these heavily armored battleships and their 16-inch guns with lightly armored littoral combat ships and 5-inch guns, vulnerable to antiship missiles, was a wise decision.

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APPENDIX

SHIP SPECIFICATIONS – IOWA CLASS

	Iowa (BB-61)	*New Jersey (BB-62)*
Builder	New York Navy Yard, Brooklyn, NY	Philadelphia Navy Yard, Philadelphia, PA
Laid Down	June 27, 1940	September 16, 1940
Launched	August 27, 1942	December 7, 1942
Commissioned	February 22, 1943	May 23, 1943
Disposition	Out of commission, awaiting donation to a museum, Suisun Bay, CA	Dedicated as a war memorial at Camden, NJ, in 2001
Displacement	(1943) 48,425 tons Standard 57,540 tons Full load	(1943) 57,216 tons Full load (1968) 57,124 tons Full load (1983) 57,353 tons Full load
Dimensions	887ft 2inLength overall 859ft 5in Waterline length 108ft 2in Maximum beam 28ft 8in Mean draft 36ft 2in Maximum draft	887ft 6in Length overall 859ft 10in Waterline length 108ft 1in Maximum beam 28ft 8in Mean draft 38ft 0in Maximum draft
Armament		
Main	Nine 16-inch/50 caliber guns (Mark 7)	Nine 16-inch/50 caliber guns (Mark 7)
Secondary	Twenty 5-inch/38 caliber guns (Mark 12)	Twenty 5-inch/38 caliber guns (Mark 12)
Missiles	(1984) 32 BGM-109 Tomahawk cruise missiles in eight armored box launchers (1984) 16 RGM-84 Harpoon antishipping missiles in four canister launchers	(1983) BGM-109 Tomahawk cruise missiles in eight armored box launchers (1983) 16 RGM-84 Harpoon antishipping missiles in four canister launchers
Antiaircraft	40mm/56 20mm/70 20mm/76 CIWS Feb 1943 60 60 none Dec 1944 80 52 none 1957 80 none none 1968 none none none Apr 1984 none none 4	40mm/56 20mm/70 20mm/76 CIWS May1943 80 49 none Dec 1944 80 49 none Aug 1945 80 41 none 1968 one none none 1983 none none 4
Armor		
Belt Armor	12.1in on 0.875in inclined 19 degrees	12.1in on 0.875in inclined 19 degrees
Lower Belt Armor	12.1in tapered to 1.625in inclined 19 degrees	12.1in tapered to 1.625in inclined 19 degrees
Deck Armor		
Main	1.5in	1.5in
Second	4.75in + 1.25in	4.75in + 1.25in
Splinter	0.625in	0.625in
Third	0.5in or 0.625in	0.5in or 0.625in
Barbette Armor		
To 2nd Deck	17.3in – 11.6in	17.3in – 11.6in
2nd–3rd Deck	3in	3in
Below 3rd Deck	1.5in	1.5in
Turret Armor		
Face Plates	17.0in + 2.7in	17.0in + 2.7in
Sides	9.5in	9.5in
Back Plates	12.0in	12.0in
Roof Plates	7.25in	7.25in
Secondary Gun Armor		2.5in
Gun Mounts	2.5in	2.5in
Handling Rooms	2.5in	2.5in
Conning Tower		
Armor Sides	17.5in	17.5in
Roof Plates	7.25in	7.25in
Bottom Plates	4.0in	4.0in
Comm. Tube	16.0in	16.0in
Machinery		
Boiler	Eight Babcock & Wilcox three drum express type boilers fitted with two furnaces and double uptakes Pressure: 565 psi Temperature: 850 °F	Eight Babcock & Wilcox three drum express type boilers fitted with two furnaces and double uptakes Pressure: 565 psi Temperature: 850 °F
Turbines	Four sets General Electric geared turbines	Four sets Westinghouse geared turbines
Shaft Horsepower	230,000 44,000 astern	230,000 44,000 astern
Maximum Speed	33.0 knots @ 202 rpm	33.0 knots @ 202 rpm
Nominal Endurance	(1945) 18,000 nautical miles @ 12 knots (1945) 15,900 nautical miles @ 17 knots (1945) 5,300 nautical miles @ 29.6 knots	(1945) 18,000 nautical miles @ 12 knots (1945) 15,900 nautical miles @ 17 knots (1945) 5,300 nautical miles @ 29.6 knots
Generators	Eight ship's service turbogenerators (1,250 kw) Two emergency diesel generators (250 kw) Total ship's service capacity: 10,000 kw, 450 volts, AC	Eight ship's service turbogenerators (1,250 kw) Two emergency diesel generators (250 kw) Total ship's service capacity: 10,000 kw, 450 volts, AC

	Missouri (BB-63)	*Wisconsin (BB-64)*
Builder	New York Navy Yard, Brooklyn, NY	Philadelphia Navy Yard, Philadelphia, PA
Laid Down	January 6, 1941	January 25, 1941
Launched	January 29, 1944	December 7, 1943
Commissioned	June 11, 1944	April 16, 1944
Disposition	Dedicated as a war memorial in 1999 at Pearl Harbor, HI	Turned over in December 2009, to Nauticus Museum, Norfolk, VA
Displacement	(1942) 45,216 tons Full load (1945) 38,988 tons Standard	(1942) 44,800 tons Full load
Dimensions	887ft 3in Length overall 860ft 0in Waterline length 108ft 2in Maximum beam 37ft 9in Maximum draft	887ft 3in Length overall 860ft 0in Waterline length 108ft 2in Maximum beam 37ft 9in Maximum draft
Armament		
Main	Nine 16-inch/50 caliber guns (Mark 7)	Nine 16-inch/50 caliber guns (Mark 7)
Secondary	Twenty 5-inch/38 caliber guns (Mark 12)	Twenty 5-inch/38 caliber guns (Mark 12)
Missiles	(1986) 32 BGM-109 Tomahawk cruise missiles in eight armored box launchers (1986) 16 RGM-84 Harpoon antishipping missiles in four canister launchers	(1988) 32 BGM-109 Tomahawk cruise missiles in eight armored box launchers (1988) 16 RGM-84 Harpoon antishipping missiles in four canister launchers
Antiaircraft	40mm/56 20mm/70 20mm/76 CIWS Jun 1944 80 49 none Dec 1944 80 49 none Nov 1945 80 43 none Apr 1954 80 none none May1986 none none 4	40mm/56 20mm/70 20mm/76 CIWS Apr 1944 80 49 none Dec 1944 80 51 none Mar 195864 none none Jul 1988 none none 4
Armor		
Belt Armor	12.1in on 0.875in inclined 19 degrees	12.1in on 0.875in inclined 19 degrees
Lower Belt Armor	12.1in tapered to 1.625in inclined 19 degrees	12.1in tapered to 1.625in inclined 19 degrees
Deck Armor		
Main	1.5in	1.5in
Second	4.75in + 1.25in	4.75in + 1.25in
Splinter	0.625in	0.625in
Third	0.5in or 0.625in	0.5in or 0.625in
Barbette Armor		
To 2nd Deck	17.3in – 11.6in	17.3in – 11.6in
2nd–3rd Deck	3in	3in
Below 3rd Deck	1.5in	1.5in
Turret Armor		
Face Plates	17.0in + 2.7in	17.0in + 2.7in
Sides	9.5in	9.5in
Back Plates	12.0in	12.0in
Roof Plates	7.25in	7.25in
Secondary Gun Armor		
Gun Mounts	2.5in	2.5in
Handling Rooms	2.5in	2.5in
Conning Tower Armor		
Sides	17.5in	17.5in
Roof Plates	7.25in	7.25in
Bottom Plates	4.0in	4.0in
Comm. Tube	16.0in	16.0in
Machinery		
Boiler	Eight Babcock & Wilcox three drum express type boilers fitted with two furnaces and double uptakes. Pressure: 565 psi Temperature: 850 °F	Eight Babcock & Wilcox three drum express type boilers fitted with two furnaces and double uptakes. Pressure: 565 psi Temperature: 850 °F
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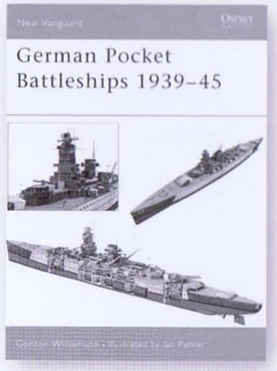
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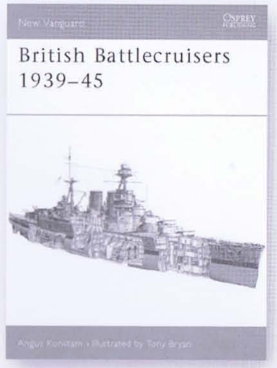
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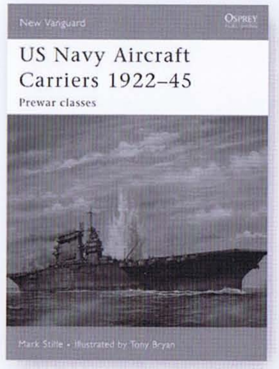
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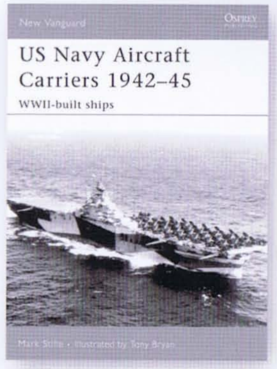
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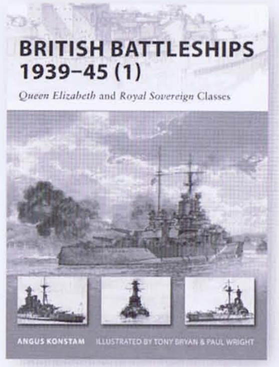
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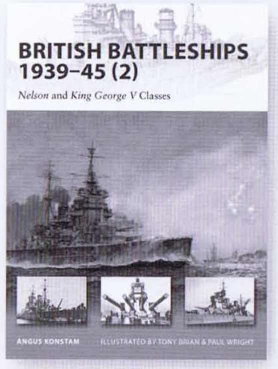
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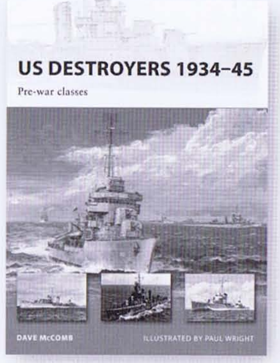
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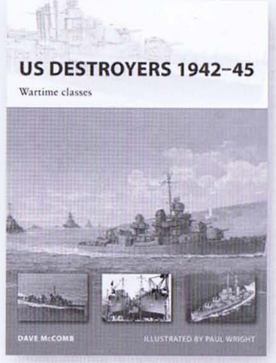
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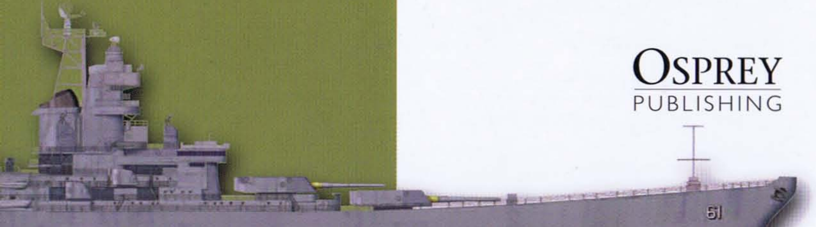

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